REPORT OF THE HEALTH AND SAFETY DIVISION
FISCAL YEAR 1949

BY J. J. FORBES AND W. J. FENE

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by

J. J. Forbes[1] and W. J. Fene[2]

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FOREWORD

Through education, investigations, and studies and an expanded coal-mine inspection program the Bureau continued to discharge the responsibility placed on it by Congress 39 years ago for promoting safety and health in the mineral industries. Although much still remains to be done, definite progress was made in combating physical and psychological hazards in mines and plants.

Accident-prevention courses for coal-mine supervisory officials and special courses for coal-mine safety committeemen were inaugurated. First-aid, mine rescue, and other safety training was conducted for those engaged in all branches of the mineral industries. Assistance was given in recovery work after mine explosions and fires. Studies to reduce the danger of roof falls, the greatest single cause of fatal mine accidents, resulted in the development and adoption of new coal-mine roof-support techniques. Knowledge of the explosion and health hazards of mine and plant dusts and ways of preventing them were advanced. Electrical equipment was tested for safety of operation in gassy coal mines, and emergency mine communications apparatus was developed and tested. More progress was made in the study of controlling flood waters that threaten life and property in the Pennsylvania anthracite region. More coal-mine inspections were made than in any previous year, and an impressive number of improvements resulted from the Federal inspectors' recommendations, even though many of them went unheeded. A program of controlling fires in inactive coal deposits on the public domain and private property was instituted during the year.

ORGANIZATION - HEALTH AND SAFETY DIVISION

The activities of the Division are supervised from 22 field offices strategically located in the various mining regions of the country.

Washington, D. C., Office

J. J. Forbes	Chief
W. J. Fene	Assistant Chief
M. J. Ankeny	Chief, Coal Mine Inspection Branch
H. F. Weaver	Assistant Chief, Coal Mine Inspection Branch
S. H. Ash	Chief, Safety Branch
D. O. Kennedy	Assistant Chief, Safety Branch

Field Offices

G. W. Grove, Supervising Engineer	Pittsburgh, Pa.
W. D. Walker, Assistant Supervising Engineer	Pittsburgh, Pa.
E. J. Gleim, Supervising Engineer, Electrical-Mechanical Section	Pittsburgh, Pa.
L. B. Berger, Acting Chief, Health Branch	Pittsburgh, Pa.
H. E. Sanford, Engineer-in-Charge	Johnstown, Pa.
M. J. Mechling, Engineer-in-Charge	St. Clairsville, Ohio
S. T. Reese, Engineer-in-Charge	Fairmont, W. Va.
E. H. McCleary, Supervising Engineer	Wilkes-Barre, Pa.

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Field Offices (Cont'd.)

H. D. Kynor, Supervising Engineer, Anthracite Flood Prevention Project	Wilkes-Barre, Pa.
J. A. Gilbert, Engineer-in-Charge, Anthracite Flood Prevention Project	Hazleton, Pa.
H. B. Link, Engineer-in-Charge, Anthracite Flood Prevention Project	Pottsville, Pa.
William Eathorne, Engineer-in-Charge, Safety Branch	Albany, N. Y.
A. U. Miller, Supervising Engineer	Mount Hope, W. Va.
E. E. Quenon, Assistant Supervising Engineer	Mount Hope, W. Va.
W. H. Tomlinson, Engineer-in-Charge	Norton, Va.
M. C. McCall, Supervising Engineer	Birmingham, Ala.
C. H. Dodge, Engineer-in-Charge	Jellico, Tenn.
James Westfield, Jr., Supervising Engineer	Vincennes, Ind.
J. A. Johnson, Supervising Engineer	Duluth, Minn.
G. M. Kintz, Supervising Engineer	Dallas, Tex.
R. D. Bradford, Engineer-in-Charge	McAlester, Okla.
E. H. Denny, Supervising Engineer	Salt Lake City, Utah
J. H. East, Jr., Engineer-in-Charge	Denver, Colo.
A. D. Look, Engineer-in-Charge	Phoenix, Ariz.
L. H. McGuire, Engineer-in-Charge	Seattle, Wash.
J. H. Bird, Engineer-in-Charge	Berkeley, Calif.

HEALTH BRANCH

INTRODUCTION

The activities during the year were directed toward the study, evaluation, and control of harmful or hazardous exposures to contaminants of the working environment in the mineral industries. Such activities include the analysis of mine atmospheres to determine the efficacy of ventilation, to assess possible hazards from toxic and flammable gases, and to aid in the control and extinguishment of mine fires; the determination and study of air-borne dusts of hygienic significance in mining operations; the examination and evaluation of various mineral materials in regard to their potentialities as sources of harmful air-borne dusts when used, processed, or produced in mining and allied industries; the testing and approval of equipment designed to afford respiratory protection against gaseous and particulate atmospheric contaminants encountered in mining and in other industrial operations; the study and analysis of ventilation and air-conditioning techniques in mining operations; the study of acid drainage from coal mines; and the dissemination of technical information on these subjects.

ANALYSIS OF GAS AND DUST SAMPLES

During the fiscal year approximately 16,000 gas and dust samples were analyzed, which required more than 100,000 determinations.

Gas Analyses

The gas laboratory analyzed 15,729 samples, of which 14,839 from coal mines and 43 from other sources were collected in connection with Federal coal-mine inspection. In comparison with the preceding year, this represents an increase of 10.1 percent in total samples analyzed and an increase of 14.0 percent in the number of samples analyzed in connection with coal-mine inspections.

Samples collected during inspections of anthracite and bituminous coal mines constituted the major part of the work of the gas-analysis laboratory. Other samples analyzed were those collected during recovery operations and investigations after mine fires and explosions; in investigations of toxic- and flammable-gas hazards in other types of mines and in tunnels and industrial establishments; and during laboratory studies pertinent to the mineral industries and the military services. Samples from coal, metal, oil-shale, limestone, barite, clay, salt, and trona mines were analyzed; from a rock quarry; from tunnels under construction; from boreholes, underground fires, and a well under construction; stack gases from steel mills and zinc plants, as related to air pollution; exhaust gases from Diesel-powered equipment used underground and from internal-combustion engines operating on butane; natural gas and compressed industrial gases; from miscellaneous minor field investigations; and from laboratory investigations.

Dust Analyses

Approximately 600 samples of dust were collected in field investigations and laboratory studies relating to the evaluation and control of health hazards in the mineral industries and in the development of procedures for the determination of air-borne dusts.

Most of these samples were collected with the midget impinger for the purpose of determining the number concentration of dust particles in the sampled air. Other determinations included X-ray, spectrographic, and petrographic examinations, and estimation of particle-size distribution. More than 1,000 such operations were conducted.

The samples consisted of a wide variety of materials, such as dusts from coal and metal mines, quarries, construction jobs, coal and oil ash, slag, limestone, and marl.

FIELD INVESTIGATIONS

As there has been considerable concern over the use of high-silica sand as traction material for coal-mine locomotives, a survey was started to evaluate the dust exposure of motormen and their helpers. The study also was extended to include investigation of dust exposures in rock work in coal mines. Twenty-three mines were visited, and 297 samples of air-borne dust were collected.

The data collected in those surveys are being assembled and analyzed and will be consolidated with the results of future investigations along the same line to obtain a representative cross section of dust conditions in various coal fields and under different operating methods.

In addition to the foregoing studies relating to haulage and rock work, complete surveys of dust conditions in all mining operations were made at two mines in West Virginia and one in Pennsylvania.

Considerable interest has been aroused in the possibility of finding materials of low silica content to use as substitutes for quartz sand as traction material for mine locomotives. Observations were made on the use of iron-ore tailings for this purpose at a mine in West Virginia, but the study has not progressed far enough to warrant definite conclusions. Other materials, such as metallurgical slags and certain minerals that might have possibilities as substitutes for traction sand, have been obtained and are being examined for free silica content, and in some instances hardness, which is a property that must be approximately the same as sand to obtain suitable traction.

LABORATORY INVESTIGATIONS

Laboratory investigations were conducted on methods of determining dust concentration, methods for large-volume sampling of air-borne dusts, performance characteristics of gas-indicating instruments, toxic gases liberated in the burning or thermal decomposition of synthetic resins, explosions and formation of carbon monoxide in compressed-air systems, fires in timber-creosoting plants, and spontaneous heating of carbonaceous shales found in some iron-mining operations.

Determination of Dust Concentration

As there is need for a simple, rapid method of obtaining approximate indication of the concentration of air-borne dust, work was continued along this line. Experiments were conducted to ascertain whether comparison of color of dust deposited on a filter paper or an adhesive-coated metal plate might be employed. To date, neither of these methods has proved satisfactory.

To obtain large samples of air-borne dust for particle-size determination and X-ray, spectrographic, and petrographic examination, the use of filter cakes of compressed salicylic acid was investigated. Filters of this type that are efficient dust collectors and that have a low resistance to air-flow have been prepared and have been given limited trials in the field. Some further development work will be required before the method may be considered entirely satisfactory.

Determination of Composition of Dust

A study of the relationship between the composition of source material and air-borne dust generated therefrom was continued. General conclusions resulting from dust-settling experiments are that (1) the quartz content of the air-borne dust decreases as the time of settling increases or as the calculated particle size decreases; (2) qualitative agreement exists between results obtained for air-settling and water-settling experiments in regard to decrease of concentration and of quartz content with increase in settling time; (3) the amount of quartz in the original sample gives little indication of the amount in suspension after a certain settling time because of the various settling rates of other minerals present in the dusts.

Rock Structure as Related to Roof Control

Studies relating to roof control have been conducted in cooperation with personnel of the Coal Mine Inspection Branch. Petrographic examinations are being made on about 150 thin sections from rock samples collected in "cutter" and "noncutter" areas. The examinations indicate that materials from cutter areas have about half the range of particle length of noncutter areas. In cutter areas carbonate grains are made up of aggregates about 1 micron in diameter; in noncutter areas the carbonate grains are whole crystals. In cutter areas quartz grains are found rarely in contact with each other; in noncutter areas quartz grains are commonly found in contact with each other. The results indicate the petrographic examination of samples from mine roofs might aid in locating areas where cutters could be expected.

Investigations for Navy Department

Experimental work was conducted for the Bureau of Ships, Navy Department, to determine the nature and quantity of toxic gases produced in the burning or thermal decomposition of a variety of synthetic plastic materials, including some of the relatively inert chloro-fluoro-polyolefins. Although these investigations have been conducted primarily to develop information on materials used as electrical insulation in naval installations, the data are valuable to the Bureau of Mines as applying generally to the use of such materials in mining and other industrial equipment.

Investigation of Causes of Carbon Monoxide Formation and Explosions in Compressed-Air Systems

Laboratory studies of the properties of carbon deposits of air-compressor cylinders have indicated that these materials contain a "carbon-oxygen complex" that may act as an initiating source of carbon monoxide formation and exothermic reactions that may lead to explosions in compressed-air systems. Experimental work was completed, and a Report of Investigations was issued on this study, which, it is believed, should provide a new basis for research and development to prevent accidents from explosions and carbon monoxide poisoning from using compressed air.

Performance Characteristics of Electric Methane Indicators

Performance tests were made of a commercial electric-methane indicator. The results of this investigation should prove of interest to coal-mine inspectors and others concerned with the reliability of such instruments as are used in examination of mine atmospheres.

Study of Materials from Timber-Creosoting Plants

Creosote and creosote coke from industrial timber-creosoting plants were investigated in an effort to ascertain the causes of unexplained fires that sometimes occur in such plants. Experiments to date have indicated that the coke is exothermically active with oxygen, although the degree of activity appears to vary considerably with different cokes and with the age of the coke.

Study of Spontaneous Heating of Carbonaceous Shales from the Menominee Iron Range of Michigan

Carbonaceous shales encountered in mining in the Menominee iron range of Michigan sometimes heat spontaneously, requiring sealing-off of the affected areas to exclude oxygen.

Studies have been under way to determine the nature of the gases produced when the shale is heated under conditions intended to simulate a sealed mine area. The purpose of the investigation is to obtain information that may be used to interpret the results of analysis of air samples collected from actual sealed areas.

Results indicate that the concentration of carbon monoxide produced under conditions of active heating are low in comparison to the concentrations usually observed in connection with coal-mine fires. The validity of this observation will be determined by similar experiments with coal.

Determination of Incombustible Material in Coal-Mine Dusts

Experiments were conducted to ascertain whether a field method might be developed for determining the incombustible content of coal-mine dusts, utilizing carbon tetrachloride as a float-and-sink medium. The experiments have been unsuccessful to date because it was found that fine particles of various coals and incombustible materials do not behave uniformly when gravity separation is attempted by immersing fine particles in carbon tetrachloride.

Determination of Mercury in Crude Oil

A colorimetric method was developed for the determination of mercury in crude oil as an aid in evaluating possible health hazards that might be involved in the production and processing of certain California crude oils that contain mercury. The method is sensitive to about one part of mercury per million parts of oil by weight.

APPROVAL TESTING OF RESPIRATORY PROTECTIVE DEVICES

Approvals and Extensions of Approvals Granted

Six new approvals and 37 extensions of approvals were granted on respiratory protective devices during the year.

Two new approvals and eight extensions of approvals were granted on supplied-air respirators. One of the new approvals was on an abrasive blasting helmet, and the other was on a type C demand-class respirator. Two new approvals and 17 extensions of approvals were granted on gas masks. One of the new approvals was on a hydrogen sulfide and petroleum vapor mask, and the other was on a universal gas mask with special filter. Two new approvals and eleven extensions of approval were granted on dispersoid respirators. One extension of approval was granted on a nonemergency gas respirator.

Permission was granted for changes in packaging two types of dispersoid respirators.

Preliminary examinations were made on several devices that were not formally submitted for testing and approval.

Tests to Determine Quality of Approved Devices

Check tests on approved gas-mask canisters showed one approved type that did not meet the performance requirements of the Bureau of Mines schedule under which it was approved. Sale of the canister was discontinued immediately at the direction of the Bureau. Through close cooperation with the manufacturer, the faults in the canister were corrected, and its sale was resumed.

Questionnaire Regarding the Approval of Paint-Spray Respirators

A questionnaire was prepared and sent to qualified persons regarding the advisability of the Bureau of Mines preparing a schedule to cover the approval testing of a paint-spray respirator. The replies to the questionnaire were analyzed, and a summary of the analysis was sent to those who submitted replies. The questionnaire proved valuable in obtaining a cross section of opinion on the subject, which should aid in the preparation of a schedule of approval requirements.

Ten men were trained in the use of gas masks in hydrogen sulfide to prepare them for emergencies that might arise in the production of sulfur from a hydrogen sulfide-bearing natural gas in a proposed plant in a Western State.

Some work was done on the particle size of test aerosols and on improving the apparatus used in the approval testing of respiratory protective devices.

MINE VENTILATION

Mine-Ventilation Field Studies

Information on ventilation developments and records was obtained at the Magma mine, Superior, Ariz., and at the Butte mines of the Anaconda Copper Mining Co. District ventilation problems were discussed with the Bureau staff at Phoenix, Ariz., and at Salt Lake City, Utah, on the same trip.

Ventilation Information and Inquiries

Information on mine and tunnel ventilation and related subjects was supplied to Bureau engineers, mine operators (including a large number of foreign visitors), and others. Various manuscripts pertaining to ventilation were reviewed, prior to publication, for Bureau engineers or at the request of technical societies. Written discussion was submitted on a paper by Cloyd M. Smith on "Underground Anemometry," which appeared in Mining Engineering (A.I.M.E.) for January 1949. A new chapter on air measurement was prepared for a proposed revision of the A.S.A. Z9 publication "Fundamentals of Exhaust Systems." Three chapters of the A.S.H.V.E. "Guide" were reviewed, and comments were submitted. Various meetings of four technical advisory committees on industrial ventilation were attended during the year.

Ventilation Research

A considerable number of references embodying new data on mine ventilation and air flow were analyzed for information required in answering inquiries or desired for possible future use in Bureau publications. A concise correlation of data on air-measurement by orifice plates was made for the chapter on air-measurement for the A.S.A. Z9 publication previously mentioned. A two-color psychrometric chart especially adapted to solving air-conditioning problems is ready for publication.

Air-Conditioning in Mines

Contact was maintained, by both correspondence and personal visit, with air-conditioning installations at the Magma mine, Superior, Ariz., and at the Butte mines of the Anaconda Copper Mining Co. At Magma, the new 1,640-ton A.C.M. Co.-type refrigeration plant has been completed except for some of the six underground units designed to be supplied by it. The first underground unit went into service in August 1948, the second in September, the third in November, and the fourth in June 1949. The number of stopes in operation has been increased and cover a larger territory than in the last few years, but average stope temperatures remain about the same. Bi-monthly temperature records of this mine are being analyzed currently for basic data on heat and moisture changes in underground air-flow circuits.

STREAM-POLLUTION INVESTIGATIONS

The work of the joint investigation conducted by the Bureau of Mines and Bituminous Coals Research, Inc., was continued by study and development of analytical methods for determining the composition and characteristics of acid mine drainage. The following titles of manuscripts that have been prepared, partly prepared, or for which the data have been assembled define the nature of the work:

1. A Point of Departure for the Determination of Acidity and Alkalinity of Coal-Mine Drainage.

2. A Rapid Method for the Estimation of Acid Sulfates in Coal-Mine Drainage.

3. Photometric Methods for Determination of Turbidity, Color, and Total Sulfates in Coal-Mine Drainage.

4. The Titration Characteristics of Acid Sulfate Salts Commonly Found in Coal-Mine Drainage.

5. The Titration Characteristics of Alkaline Carbonates Common to Coal-Mine Drainage.

DISSEMINATION OF INFORMATION

Three hundred thirty-eight (338) persons visited the Health Branch during the year to obtain first-hand information on the determination, physiological effects, and control of harmful gases, vapors, dusts, fumes, and mists; on ventilation and respiratory protective devices; and on other technical matters.

Among the visitors were 57 persons from 17 foreign countries - 16 from Sweden, 7 each from England and Japan, 6 from France, 4 from Canada, 3 each from Australia and India, 2 from the Netherlands, and 1 each from Brazil, Czechoslovakia, Finland, Greece, Korea, Nova Scotia, Poland, Switzerland, and the Union of South Africa.

In addition, numerous requests for technical information were answered by correspondence.

Six talks were given at meetings, and six publications were issued; also, numerous confidential reports were prepared.

Members of the staff served on committees of the American Standards Association, the National Safety Council, the American Society of Heating and Ventilating Engineers, and the National Research Council and thus assisted in the promotion of health and safety programs.

SAFETY BRANCH

INTRODUCTION

The Safety Branch is engaged in the promotion of safety in the mineral industries. The work is of two general classes - (1) educational, advancing the knowledge of the inherent and recurrent hazards of these industries and the means of preventing injury and loss of life, and (2) investigative, whereby additions are constantly being made to the mass of factual information and experience upon which the publications, standards, and recommendations of the Bureau are based. Instruction is given in accident prevention for mine officials and miners in noncoal mines; first aid to the injured; the use and care of oxygen-breathing apparatus; and advanced mine rescue and recovery operations. A specialized safety course is offered to the petroleum and gas industries. Branch personnel also aids in or directs rescue and recovery work after mine fires and explosions; assists at first-aid and mine rescue contests; conducts safety exhibits and demonstrations; and presents safety talks, often accompanied by sound safety motion pictures or lantern slides, before employee and official groups, at meetings of Holmes safety chapters, at mining institutes, and at other safety or technical gatherings. Coal-mine fires and explosions are investigated; also quarry accidents, metal-mine explosions and fires, miscellaneous accidents, health and safety hazards, and safety conditions at mines and plants; safety devices are investigated and developed. Field studies cover ventilation, methods of allaying suspended coal dust, prevention of dust accumulations, the proper use of rock dust to prevent or confine explosions, explosives practices, and the care and use of underground equipment. The results of these studies and investigations are widely applied in the various training courses and are prepared as reports and recommendations, which are submitted to interested persons or are combined and distributed to the public as bulletins, technical papers, miners' circulars, information circulars, and reports of investigations.

Organization and Personnel

The Safety Branch employs 73 engineers, 5 safety representatives, and 6 safety instructors, who work from 21 safety stations and 5 field offices. In addition, there are 37 clerks and 15 other employees, making a total of 136 field employees. Three engineers, a safety representative, and six clerks are employed in the Washington office.

The Electrical-Mechanical Section of the Health and Safety Division is headquartered at Pittsburgh, Pa. E. J. Gleim, electrical engineer, supervises the work of the section, and he and 13 members of his staff are a part of the Safety Branch.

The Anthracite Flood-Prevention Project of the Safety Branch is headquartered at Wilkes-Barre, Pa., with suboffices at Hazleton, Scranton, and Pottsville, Pa. H. D. Kynor, Sr., supervises the work of the project, assisted by W. M. Romischer at Wilkes-Barre, H. E. Jenkins at Scranton, J. C. Gilbert at Hazleton, and H. B. Link at Pottsville.

SAFETY EDUCATION WORK

First-Aid and Mine Rescue Training

An important feature of the work of the Safety Branch is the giving of instruction in methods of first aid to the injured and in the use and care of various kinds of mine rescue apparatus.

During the fiscal year ended June 30, 1949, 29,778 persons employed in the mining and allied industries were given a full course in first aid and 2,527 in mine rescue methods, a total of 32,305. Since the inception of this training program in 1910, 1,737,794 persons in the mineral industries have been trained in this important work. Table 1 shows the record of first-aid and mine rescue training by industries.

In addition, 36,046 persons not connected with the mining or allied industries, but living in or near such localities, and children under 16 years of age have taken the course. Virtually all such training has been done in regular classes conducted for the mineral industries at no additional cost. During the fiscal year 1949, 638 such persons were given first-aid training by the Bureau and received letters certifying to that fact.

TABLE 1. - First-aid and mine rescue training, by industries, July 1, 1910-June 30, 1949

Industries	7/1/10-6/30/48			7/1/48-6/30/49			Total		Grand Total
	First aid	Mine rescue	Total	First aid	Mine rescue	Total	First aid	Mine rescue	
Cement........	16,091	60	16,151	650	-	650	16,741	60	16,801
Coal mining...	1,099,150	72,192	1,171,342	12,706	1,283	13,989	1,111,856	73,475	1,185,331
Metal mining..	178,772	8,956	187,728	3,534	702	4,236	182,306	9,658	191,964
Metallurgical.	53,798	1,063	54,861	2,486	19	2,505	56,284	1,082	57,366
Miscellaneous.	75,262	6,937	82,199	3,488	514	4,002	78,750	7,451	86,201
Nonmetallic mining[1/]....	28,180	370	28,550	529	9	538	28,709	379	29,088
Petroleum.....	155,251	102	155,353	6,355	-	6,355	161,606	102	161,708
Tunnel work...	8,560	745	9,305	30	-	30	8,590	745	9,335
Total....	1,615,064	90,425	1,705,489	29,778	2,527	32,305	1,644,842	92,952	1,737,794

[1/] Nonmetallic mining includes such industries as quarrying of limestone, granite, etc., and mining of mica, salt, fluorspar, and other nonmetallic minerals.

Employers now realize that if all employees are given this training, especially first aid to the injured, they become safer workmen. As a direct result of the first-aid training given in the United States, it is estimated conservatively that at least 200 lives are saved annually.

During and since fiscal year 1945, the Bureau of Mines has entered into an agreement plan of first-aid and mine rescue training with various companies. Qualified persons are designated as examiners who can make recommendations for first-aid, mine rescue, and instructors' certificates and cards.

During fiscal year 1949, 87 certificates were issued to mines and plants, at which 5,812 men were trained, in 16 States and Canada; this training was for 19.51 percent of the total first-aid training for the year. To June 30, 1949, 3,100 mines, plants, and local unions have been issued certificates or renewals of certificates for 100-percent first-aid training, at which 536,036 persons have been trained, in 40 States, Alaska, the District of Columbia, and Canada.

Provisional and Permanent First-Aid and Mine Rescue Instructors

In August 1930 a plan was inaugurated to issue first-aid instructors' certificates to persons who satisfactorily train classes and who are recommended as qualified by Bureau representatives. The issuance of instructors' certificates greatly assists the Bureau and the industries in the proper maintenance of first-aid work.

During the fiscal year 1949, 295 provisional first-aid instructors' certificates were issued; 11 instructors' certificates that require no renewal were issued; and 250 certificates were renewed, 24 of them for the fifth time and with permanent certificates requiring no further renewals. A total of 18,004 instructors' certificates have been issued to June 30, 1949.

During the fiscal year 1939, mine rescue instructors' letter certificates were issued for the first time. These certificates are issued to persons who have participated in mine rescue training for at least 5 years, have instructed and directed mine rescue training of at least 5 men, including the direction of underground maneuvers and the teaching of the properties and detection of mine gases, and have maintained oxygen breathing apparatus, gas masks, etc., in first-class condition for at least a year. The applicant must hold an oxygen breathing apparatus (mine rescue) certificate and must pass a rigid examination given by a Bureau representative. During the fiscal year 1949, mine rescue instructors' letter certificates were issued as follows: 2 permanent, 16 provisionals, 7 first renewals, 4 second renewals, 3 third renewals, and 1 fifth renewal. From July 1, 1939, to June 30, 1949, 268 mine rescue instructor certificates have been issued.

Training in Advanced Mine Rescue and Recovery Operations

A special or advanced course of instruction for mine officials in directing rescue and recovery work after mine disasters was started in 1926. During the fiscal year 1949, 11 certificates were issued to men who completed this course. To June 30, 1949, certificates have been issued to 4,045 men; 134 have taken additional training; and 360 have taken partial training.

First-Aid and Mine Rescue Contests

The 27 first-aid and mine rescue contests in which Bureau safety men actively assisted during the year were held in 10 States; 307 teams participated, and approximately 37,220 spectators witnessed the contests. From 1932 to June 30, 1949, Safety Branch men have attended and assisted in 880 first-aid and mine rescue contests held in 31 States, Alaska, and British Columbia.

First-Aid Judges' Course

During the fiscal year 1939, a course to train first-aid judges was initiated, and 305 men completed the course, 13 in Pennsylvania and West Virginia taking only partial training.

During the fiscal year 1942, this course was revised to conform with the Manual of First-Aid Training, and classes have been conducted in Pennsylvania in both the anthracite and bituminous-coal fields. During the fiscal year 1949, training for first-aid judges was extended to the petroleum industry. To be eligible to take this training, a person must have a Bureau of Mines first-aid certificate, must be familiar with the latest first-aid manual, must be thoroughly familiar with the discount sheet, should have had experience in instructing classes or teams in first aid or have received training from the Bureau of Mines to act as judge, must be impartial and strict, should be accurate and considerate as to the discounts, and be honest with the team.

The course consists of four 3-hour classes, or 12 hours. A first-aid team works various types of problems, and the men taking the course judge the work and report findings, which are discussed by the instructor. Pocket-card certificates are given to persons completing the course.

One hundred twenty-two persons completed the course in this fiscal year and 1,340 persons have taken the course since its inauguration.

Metal-Mine Accident-Prevention Course

Classes in an accident-prevention course for metal miners were first conducted during the fiscal year 1942. During the fiscal year 1949, 1,232 metal miners received training in this course and 3,752 miners have completed it.

Course in the Use of Explosives

During the fiscal year 1945, a new course in the safe handling and use of explosivesand blasting devices in bituminous-coal mines was initiated for shot firers and other persons concerned with the handling and use of explosives. One thousand one hundred and eighty seven persons have completed this course satisfactorily.

Petroleum Educational Work

Petroleum Gas Course

During the fiscal year 1939, a course of safety instruction was initiated for persons in the petroleum industry. It was considered desirable that those who take this course be operating officials or selected persons like those who take the accident-prevention course for coal-mine officials. At least eight 2-hour lectures (16 hours) are required to complete the course. One thousand eight hundred and four persons have completed this course satisfactorily, and 2,556 persons have partly completed it.

Magic of Fire Lecture and Demonstration

During the fiscal year 1949, engineers of the Safety Branch presented the lecture and demonstration on the flammability of gasoline vapors, entitled "Magic of Fire," at 155 safety meetings in 21 States; the total attendance at these meetings was 16,115.

Exhibits and Demonstrations

Demonstrations were confined to audiences composed of persons connected with the mineral industries, were of a nature designed to illustrate the immediate hazards, and included the demonstration of coal-dust explosibility and the dangers of electric arcs and sparks in coal dust.

During the fiscal year 1949, personnel of the Health and Safety Division participated in 142 exhibits and demonstrations in 22 States, at which there were 49,637 spectators.

During the past 4 years, 363 exhibits and demonstrations in connection with fairs, conventions, and exhibits have been conducted by Health and Safety Division personnel in 32 States.

Holmes Safety Association Activities

In 1922 the Joseph A. Holmes Safety Association began sponsoring the organization of local safety chapters designed to promote safety in the mineral and allied industries through safety-educational and safety-inspirational methods. By authority granted at the annual meeting of its board of directors on March 5, 1926, the Holmes Safety Association assumed direction and control of all Joseph A. Holmes safety chapters then in existence and all others established thereafter. One of the principal objectives of those local chapters is to bring about greater cooperation on the part of employers and employees with other agencies, such as the Bureau of Mines and State departments of mines in the promotion of safety.

The Safety Branch has been active for many years in promoting this organized safety effort, and members of the Safety Branch have organized a total of 534 local safety chapters. During the fiscal year 1949, one new chapter was organized.

The regular meetings of the district councils and local chapters of the Holmes Safety Association are utilized by the Safety Branch of the Bureau of Mines in educating the workers and officials in safety practices. During the fiscal year 1949, 48 such meetings were held in Pennsylvania, and were attended and addressed by members of the Safety and Coal-Mine Inspection Branches on many subjects relating to safety.

The Pennsylvania State Bituminous Council of the Holmes Safety Association has been functioning since January 1942. Six district councils are affiliated with the State council, and 82 chapters are affiliated with the 6 district councils. Each district council conducts a safety contest on a monthly and yearly basis for a safety banner, and the State council conducts a similar contest among the affiliated district councils.

The value of Holmes safety chapters and councils in promoting safety is unquestioned. Many years of experience with this type of work, in which the records have been watched carefully, has proved that wherever chapters and councils have been organized and the meetings have been carefully planned and conducted, substantial reductions in accident rates have followed almost invariably.

Holmes safety organizations in the field continue to be excellent means through which the Safety Branch can carry out one of its primary objectives, that of disseminating information on accident prevention in the mining and allied industries.

Safety Educational Sound Motion Pictures

During the fiscal year 1949, sound motion pictures produced by the Safety Branch were shown in 199 exhibitions, attended by 10,765 persons employed in or associated with the mineral industries. To June 30, 1949, Safety Branch motion pictures have been shown 2,854 times to a total of 251,687 persons.

Fourteen copies of the revised motion picture "Coal Mine Explosion Prevention", consisting of 22,000 feet of film, were made and are being exhibited.

A sound-and-color motion picture, "Color for Safety on Drilling Rigs," illustrating the advantages of and need for the use of a color safety code in the oil well-drilling industry, was completed and had its initial exhibition at Dallas, Tex., on May 23, 1948.

The motion picture personnel collaborated with the staff of Dr. E. J. McCague, Chief of the Department of Urology of the Mercy Hospital, Pittsburgh, Pa., in the production of a motion picture dealing with the proper handling, first-aid, and hospital treatment of victims of pelvic-region injuries in industrial accidents.

A film strip with commentary was made depicting the principles and application of the "roof-bolting" method of roof support for field use. Considerable underground "still" photography was done on roof-bolting projects and on numerous other coal-mining subjects. Models demonstrating the principles of roof-bolt supports were photographed and prepared for use.

Safety Meetings Attended and Addressed

During the fiscal year 1949, personnel of the Safety Branch attended 593 safety meetings, which 66,157 persons attended. These figures compare with 986 meetings and an attendance of 83,878 in 1948.

At most of these meetings, safety demonstrations were conducted, motion pictures were shown, or some phase of safety was discussed by a representative of the Bureau, with particular emphasis on the prevention of explosions in coal mines.

INVESTIGATIVE WORK

Mine Explosions and Fires

The investigation and study of mine explosions and fires, which originated in 1910 immediately after the organization of the Bureau, are usually conducted by employees of the Safety and Coal Mine Inspection Branches. Covering virtually every mine explosion and serious mine fire in the United States for the past 39 years, these investigations result in the determination of direct causes of mine disasters or assign degrees of probability to possible causes, and also weigh the importance of contributory conditions that influence the extent, violence, loss of life, and the ease or difficulty of recovery experience in each instance. Much of the improvement in mining methods, explosion prevention, fire prevention, and modern equipment may be justly attributed to the knowledge gained and information published on the results of these investigations.

During the fiscal year 1949, 23 mine explosions that resulted in 40 deaths and 35 mine fires, which took 11 lives, were investigated by employees of the Health and Safety Division. Three major disasters occurred during the fiscal year 1949 - two explosions, in which 24 lives were lost, and one fire, in which 5 lives were lost.

Miscellaneous Accidents

During the fiscal year 1949, 132 miscellaneous accidents were reported, including accidents from roof falls, premature explosions, explosions in plants and buildings, asphyxiations, etc., 4 of which were major accidents (5 or more lives lost) in which 157 lives were lost. In many instances a thorough investigation was made of the accident, and a report was submitted in which recommendations were made to prevent recurrence.

Special Health and Safety Investigations

During the fiscal year 1949, 46 safety and health-hazard investigations were conducted by personnel of the Health and Safety Division. The safety inspections included a study of practices, conditions, and equipment, and sampling and analysis of mine air and dust.

Miscellaneous Reports

Letter reports also are prepared by the personnel of the Health and Safety Division, which supply information for Bureau records regarding conditions, practices, and equipment observed at mines and plants. During the fiscal year 1949, 380 such reports were prepared.

INSPECTION OF PRIVATELY OWNED MINE RESCUE APPARATUS

A number of the larger mining companies throughout the United States maintain their own mine rescue stations and crews of trained men. In some districts, a central mine rescue station is maintained by several companies in the district. In one State (Utah) the mining law provides that mine rescue apparatus shall be maintained at all coal mines employing 50 or more men.

For several years it has been the practice of Safety Branch field men to inspect thoroughly the mine rescue facilities when visiting plants where such facilities are maintained. A report is then submitted to the operator describing the condition of the equipment and station and making recommendations for the proper care and maintenance thereof.

During the fiscal year 1949, 20 privately owned mine rescue stations in 11 States were inspected by employees of the Safety and Coal-Mine Inspection Branches. The results of these inspections disclose that in some instances the apparatus was not maintained in safe working condition and that the employees are not properly trained. Realizing that wearing mine rescue apparatus not in first-class condition may be disastrous in irrespirable atmospheres, Bureau representatives have assisted in reconditioning such equipment.

MANUSCRIPTS PREPARED FOR PUBLICATION AND FOR READING BEFORE MEETINGS

During the fiscal year 1949, employees of the Health and Safety Division prepared 79 manuscripts for publication in the technical press or by the Bureau of Mines and for reading before meetings.

OUTSTANDING ACCOMPLISHMENTS ATTAINED THROUGH COOPERATION WITH THE MINING INDUSTRY

During the fiscal year 1949, Bureau of Mines safety instructors trained 32,305 employees of the mining and affiliated industries in first aid and mine rescue of which approximately one-third were trained under a plan of training agreed on with various companies. This is an important safety achievement. Up to June 30, 1949, 1,737,794 persons were trained in first aid and mine rescue. Also, 297 persons were trained as first-aid instructors, making a total of 18,004 instructors' certificates issued since 1931.

There were 87 certificates awarded to mines and plants showing that all workmen therein had been trained in first aid; such training represented 19.51 percent of the total first-aid training for the year. During the fiscal year 1949, 72.2 percent of the training was done cooperatively.

Initial mine rescue training was given to 1,413 men during the year, and, in addition 1,114 men were given retraining.

Accident-prevention courses were conducted for officials and employees of metal mines and of the oil industry during the year, as follows:

	Completed	Partial
Metal-mine accident prevention.............	1,019	213
Course in the use of explosives............	17	-
Petroleum gas course.......................	296	288

At the following colleges and schools 1,389 students received first-aid training and 343 received mine rescue training: Michigan College of Mining and Technology, University of Utah, University of Idaho, University of Alabama, Colorado School of Mines, Montana School of Mines, University of Washington, Lafayette College, University of California, West Virginia University, Penn State Mining Extension School, New Mexico School of Mines, University of Kentucky, University of Arizona, Missouri School of Mines, University of Pittsburgh, Benton Township High School, and Hurley High School.

During the fiscal year 746 employees of Federal Agencies received first-aid training and 11 received mine rescue training. Five hundred and ninety employees of municipal governments received first-aid training and six received mine rescue training. These are included in the 3,488 persons trained in first aid and 514 trained in mine rescue for miscellaneous agencies.

A study of the occurrence of mercury in the Cymric oil field of California was carried on by engineers of the Safety Branch in conjunction with several of the larger oil companies.

Tests of emergency mine communication radio sets were conducted in the principal mining regions of Idaho, Montana, Arizona, and New Mexico. Tests have been made through strata of sedimentary, igneous, and metamorphic rocks to explore the relationship between the effectiveness of transmission of signals and the nature of the intervening rock.

Carbon dioxide was used successfully to extinguish a fire in the Valier mine, Valier Coal Company, Valier, Illinois. The mine had been idle for about four weeks, and considerable time was saved by the use of carbon dioxide.

As a result of the recommendations made by engineers of the Safety Branch during their inspection of the Perco copper sweetening process at the Alamo Refinery of the Phillips Petroleum Co., Berger, Tex., all reinforcing metal, piping, and other conducting surfaces upon which static electricity could accumulate were grounded electrically.

A cooperative study of Diesel locomotives was started in the experimental mine of the Colorado School of Mines.

Tests were made by Bureau personnel at two plants in California to demonstrate to inspectors from the Division of Industrial Safety and the California Insurance Fund the operating procedures of ground testing equipment. These departments plan to equip their offices with similar testing devices and are being assisted in their preparations by Bureau engineers.

A fire-extinguishment study with dry ice and Bureau of Mines equipment was made at a sealed coal-mine fire in Washington in conjunction with State mine inspectors and company officials.

A large number of oil companies and drilling contractors have adopted a standard safety color code promoted by Bureau of Mines engineers. The motion picture "Color for Safety on Drilling Rigs", made during the year by Bureau engineers in the southwestern oil fields shows effectively the use of the color code.

ANTHRACITE INVESTIGATIONS

During the fiscal year 1949, the engineers of the Anthracite Flood-Prevention Section continued their work pertaining to underground water pools, the "buried valley" of the Susquehanna River, and other phases of work related to the underground-water problem in the anthracite region. During the fiscal year 1949, the personnel and scope of work of the Anthracite Flood-Prevention Section were greatly expanded, and the name was changed to Anthracite Flood-Prevention Project. The work of the project is now handled at four field offices, consisting of a main field office at Wilkes-Barre, Pa., and three subfield offices at Scranton, Hazleton, and Pottsville, Pa., respectively. An outline of accomplishments is given below:

WATER POOLS IN PENNSYLVANIA ANTHRACITE MINES

The survey of the water pools was completed and revealed that is 91 billion gallons of water was impounded in 159 pools in underground workings and 2.3 billion gallons was impounded in abandoned stripping excavations. The results of the survey were published as Technical Paper 729, entitled "Water Pools in Pennsylvania Anthracite Mines," by S. H. Ash, W. L. Eaton, Karl Hughes, W. M. Romischer, and J. Westfield.

BURIED VALLEY OF THE SUSQUEHANNA RIVER

One phase of the mine-water problem, pertaining to the Northern Field of the anthracite region, is the presence of the buried valley (filled ancient channels) of the Susquehanna River. The present river channel is above the channels of the ancient waterway, which the north branch of the Susquehanna River has filled with clay, sand, and gravel. This valley fill is water-bearing and irregular in shape and depth. In some places the depth of the deposited material is more than 300 feet (generally it is 100 to 150 feet). The coal measures or anthracite-bearing formations lie beneath and outcrop beneath and at the sides of these deposits.

A vast tonnage of anthracite has been mined from the area beneath the buried valley and, because a large tonnage remains unmined, it is of prime importance that present and future mine operations in this area know the configuration, extent, and nature of the water-bearing deposits and the relative position of the underground workings to them to prevent the mine workings breaking into the valley-fill deposits unexpectedly with resultant loss of life and property.

Much time, effort, and money have been expended on investigative work regarding the buried valley. The anthracite companies that have mines under and adjacent to the buried valley have drilled thousands of boreholes from the ground surface through the river wash to bedrock or the underlying anthracite beds. Although each mining company has a complete record of the extent and configuration of the river wash (valley-fill deposits) in the vicinity of its own properties, no attempt had been made to correlate this information with other company records to produce a comprehensize report that would show the entire extent, configuration, and nature of the entire buried valley.

The engineering personnel of the Wilkes-Barre office is continuing the compilation of all pertinent data relative to the buried valley, such as borehole logs and information obtained during excavation of shafts, slopes, wells, and quarries. Contour maps on 10-foot intervals of the rock surface underlying the valley-fill deposits are being made and, when completed, will cover the mining area underlying and adjacent to the buried valley.

To date, information on approximately 13,000 boreholes has been compiled and coordinated; and from this and other information, 57 contour maps have been prepared. In addition to the borehole records and the maps prepared, work has been done on the text to be used in a proposed bulletin on the buried valley of the Susquehanna River. Also, numerous conferences have been held with the engineering and operating personnel of the coal companies that operate mines in the buried valley area in an effort to obtain all known information pertinent to this subject.

ANTHRACITE FLOOD-PREVENTION PROJECT

Considerable time was spent in expansion and reorganization of the Anthracite Flood-Prevention Project. Suitable office space had to be obtained for the greatly expanded main field office force at Wilkes-Barre and also at the three new subfield offices at Scranton, Hazleton, and Pottsville, Pa., respectively. Office furniture, and engineering and clerical supplies had to be procured to properly equip the offices. Contracts to furnish light, telephone, and other services at each office had to be executed. To obtain the competent engineering and clerical help required to staff the various offices, it was necessary to interview a considerable number of applicants.

At the beginning of the fiscal year, the personnel of the Anthracite Flood-Prevention Section consisted of three engineers and one clerk-stenographer. At the present time, the personnel consists of 20 engineers, 8 draftsmen, 1 clerk, 6 clerk-stenographers, and 2 clerk-typists.

The duties of the Anthracite Flood-Prevention Project are:

1. To obtain and evaluate information relating to the anthracite mine-water problem, the causes of surface-water infiltration, and the location and amounts of water accumulating in such mines that can be used to determine the remedial measures that would offer the best opportunities for re-establishment of the anthracite industry on a sound basis.

2. To obtain and evaluate information relating to the anthracite mine-water problem as a basis for the preparation of reports, studies, statistics, and other educational materials pertaining to the prevention or control of surface-water infiltration into such mines and to the protection of operating mines from the dangers and hazards of water accumulating against barrier pillars.

3. To prepare a report to the Congress upon the basis of the engineering information obtained, containing comprehensive recommendations for remedial measures concerning the anthracite mine-water problem that will outline methods for its solution, costs thereof, benefits to the region, and methods of financing.

The work being done at the main field station and the three subfield stations is described as follows:

Wilkes-Barre Main Field Station

1. Gathering data; writing script; and preparing plans, cross sections, and longitudinal sections (through the anthracite measures and overburden) for a proposed paper on the buried valley of the Susquehanna River, one of the principal causes of surface water infiltration.

2. Completion of a study of deep-well pumps and deep-well pumping installations throughout the anthracite region and making a study of horizontal centrifugal pumps and pumping installations.

3. Studying the water conditions in the Wyoming Valley region with a view towards recommending projects to alleviate these conditions.

4. Directing and co-ordinating the work being done by the various subfield offices.

Scranton Subfield Office

1. Investigating the feasibility of a tunnel from the Moosic Saddle or Pyne Barrier to Coxton to drain overflow of the Lackawanna Basin of the Northern Field into the Susquehanna River. Extensive surveys were made to verify existing "bench mark" elevations and to obtain information on surface features throughout this area. It was found necessary to broaden this survey to include a considerable portion of the Wilkes-Barre area, especially to obtain elevations at the shaft collars of a number of collieries.

2. Gathering data on the extension of the buried valley in the area of the Lackawanna River above the junction of the Susquehanna and Lackawanna Rivers.

3. Gathering data on existing pumping facilities in the entire Northern Field.

Hazleton Subfield Office

1. Estimating recoverabe anthracite tonnage now inundated by underground water pools.

2. Gathering data on existing pumping facilities in the Eastern Middle Field and the eastern part of the Southern Field.

3. Gathering data on existing drainage tunnels.

4. Checking location and measuring amount of natural overflow from underground water pools from tunnels, cave holes, rock fissures, etc., by means of flow meters and weirs.

Pottsville Subfield Office

1. Investigating the possibility of driving a tunnel from Mahanoy City to Shumakersville.

2. Gathering data on existing pumping facilities in the Western Middle Field and the western part of the Southern Field.

3. Verifying location and measuring amount of natural overflow from underground water pools from tunnels, cave holes, rock fissures, etc., by means of flow meters.

4. Gathering data on additional underground water pools developed since latest survey described in Technical Paper 727, entitled "Water Pools in Pennsylvania Anthracite Mines," which was published during the fiscal year 1949.

ELECTRICAL-MECHANICAL SECTION

INTRODUCTION

The Electrical-Mechanical Section continued its activities during the fiscal year 1949 to improve safety in coal mines as follow: (1) Investigation of electrically operated machines and appliances to determine whether their construction was such as to minimize gas and dust ignition hazards as well as shock hazards; and (2) research to determine cause and prevention of accidents resulting from men working with or around electric equipment.

This work consisted mainly of inspections and tests to determine whether the various new types of machines and appliances submitted for approval complied with Bureau of Mines standards ("schedules") that prescribe the safety features that must be built into equipment used in gassy coal mines. Such compliance is necessary before the equipment can receive formal approval for "permissible" classification, which authorizes its operation in gassy mines.

Approval work is conducted under ten different schedules. Fifty-three formal approvals were granted during the fiscal year 1949. This indicates a continued increase in demand for permissible equipment as a result of Federal inspection of coal mines. Tests to determine flame resistance were made on 102 trailing cables.

Special investigations were conducted for the Navy Department to aid in reducing fire and explosion hazards when operating electrical equipment on vessels and aircraft where gasoline vapors might be present.

APPROVAL WORK, FISCAL YEAR 1949

1. (a) Complete Motor-driven Equipment, Schedule 2E:

Investigation, including more than 3,300 explosion tests of 109 compartments and inspections of 95 explosion-proof enclosures, as well as examination of a large number of drawings and specifications led to formal approval of the designs for the following equipment (the product of 12 manufacturers): 21 loading machines and conveyors, 1 continuous miner, 1 mining machine, 1 mining-machine truck, 5 drilling machines, 2 battery-operated utility trucks, 1 battery-operated shuttle car, 2 air compressors, 1 post puller, 1 timbering machine, 5 fan-drive units, 1 greasing truck, 1 junction box, 1 distribution box, 1 car-spotting hoist, 3 rock-dust distributors, and 1 cleaner.

One hundred and twelve formal and 1,619 informal extensions of approval were granted to permit changes in approved equipment after examination of new and revised drawings.

Flame-resistant trailing cables are now required by law in one State and by the Federal Mine Safety Code as a protection against mine fires. Under an amendment of Schedule 2E, 102 samples of cables, (the product of 11 manufacturers) were tested for flame-resisting properties. This work required 483 tests of separate 6-foot lengths of cable. Check tests of four samples procured from mines were made for the Pennsylvania Department of Mines.

(b) Explosion-proof Parts for Permissible Machines, Schedule 2E:

As a service to builders of permissible machines who do not manufacture explosion-proof motors, controllers, and other electrical parts for their machines, investigation was made of 28 motors, 9 starters, 6 switches, 2 controllers, 3 reversers, 3 cable reels, 2 headlights, 2 contactor cases, and 4 miscellaneous parts. Formal reports covering these parts were issued to the respective manufacturers.

2. Electric Mine Lamps, Schedules 6D and 10C:

A new design of Edison cap lamp was examined and tested for permissibility, and Approval No. 29 to cover it was issued. Eight extensions of approvals were issued for changes in various portable electric lights.

3. Flame Safety Lamps, Schedule 7C:

A new design of Wolf flame safety lamp of smaller height and weight than formerly approved models passed the prescribed tests and inspections for permissibility, and approval No. 210 was issued for this design.

4. Portable Methane Detectors, Schedule 8C:

Two extensions of approvals were granted to permit changes in two portable methane detector designs. Thirteen permissible methane detectors sent in from the field by Federal coal-mine inspectors were adjusted and tested for accuracy.

5. Mine Telephones and Signaling Devices, Schedule 9B:

Two extensions of approvals were granted for changes in design of two permissible mine telephones.

6. Electric Shot-Firing Devices, Schedules 12D and 16B:

Inspections and tests were completed on one battery-condenser type 10-shot blasting unit and one electro-magnetic single-shot blasting unit. Formal approvals were issued for both of these designs. Two extensions of approvals were issued for changes in design of permissible blasting units.

7. Diesel-Powered Equipment for Coal and Noncoal Mines, Schedules 22 and 24.

The Electrical-Mechanical Section has been assigned the responsibility of conducting approval work on Diesel-powered equipment for both coal and noncoal mines. Although no applications for approval of such equipment have been received, manufacturers are showing considerable interest by numerous inquiries as to the requirements.

MISCELLANEOUS

(a) Visual Lessons in Safety:

One hundred ninety-seven visitors witnessed demonstrations in the Electrical Laboratory, showing how mine gas may be ignited by arcs and sparks, such as might occur when electric circuits are damaged or when improper electric equipment is used in coal mines. These demonstrations bring out the value of permissible equipment as a means of reducing gas ignitions of electrical origin.

Cooperation with Federal Mine Inspectors

In addition to assistance given in maintaining the accuracy of methane detectors used by Federal coal-mine inspectors, numerous questions were answered regarding the permissibility of inspected equipment and the safety of electrical installations in mines. Assistance also was given in the training of 85 new inspectors. Twelve reports by mining electrical engineers, covering their inspections of electrical installations at mines, were reviewed, and comments were offered concerning additions or clarification.

Cooperation with Navy Department

Investigations of electrical equipment for shipboard and aircraft use were continued for the Navy Department. This work involved (1) test of one fuel gage under various circuit conditions and (2) experiments in photography of flame discharged on failures during explosion tests.

COAL MINE INSPECTION BRANCH

INTRODUCTION

The Coal Mine Inspection Branch of the Health and Safety Division, Bureau of Mines, was established to carry out an Act of Congress, May 7, 1941, Public Law 49, 77th Congress, H. R. 2082. The series of major disasters that beset the coal-mining industry in 1940 aroused public interest in mine-safety measures, which resulted in the enactment of this legislation. Under the provisions in the act, the Secretary of the Interior, acting through the United States Bureau of Mines, is authorized and empowered to make or cause to be made annual or necessary inspections and investigations in coal mines, the products of which regularly enter commerce or the operations of which substantially affect commerce.

The principal object of the inspections is to reduce accidents in coal mines by revealing, through personal conferences with mine personnel and published reports, unsafe and unhealthful conditions and practices existing therein, and by recommending means for their elimination or amelioration. The act does not provide enforcement powers; therefore, compliance with the inspectors' recommendations is not mandatory insofar as the act is concerned.

The act also authorizes and directs the Secretary of the Interior, acting through the United States Bureau of Mines, to expend the funds made available to him for the protection or advancement of health or safety in coal mines and for the prevention or relief of accidents or occupational diseases therein, in such lawful manner as he may deem most effective in the light of the information obtained under the act to promote the accomplishment of the objects for which such funds are granted. To comply with such directive, the Coal Mine Inspection Branch personnel is conducting a Nation-wide accident-prevention educational program for coal-mine officials and coal-mine workmen. In addition, special studies are made of mine safety problems relating to roof support, ventilation, mine disasters, dusts, explosives, transportation, electricity, etc.; the results of such studies and any improved methods determined from research theron are made available to the mining industry and general public through published reports.

The National Bituminous Coal Wage Agreement of 1948, effective July 1, 1948, to June 30, 1949, provided in part as follows under "Mine Safety Program:"

> (a) Mine Safety Code.
>
> The Federal Mine Safety Code for bituminous-coal and lignite mines of the United States, adopted pursuant to an agreement dated May 29, 1946, between the Secretary of the Interior and the President of the United Mine Workers of America and promulgated July 24, 1946, is hereby adopted and incorporated by reference in this contract as a code for health and safety in bituminous-coal and lignite mines---.
>
> (b) Enforcement.
>
> (1) Reports of Federal Coal Mine Inspectors; - wherever inspectors of the Federal Bureau of Mines, in making their inspections in accordance with authority as provided in Public Law 49, 77th Congress, find that there are violations of this code and make recommendations for the elimination of such noncompliance, the Operator shall promptly comply with such recommendations, except as modified in paragraph 2 of this subdivision (b).
>
> (2) Whenever either party to the contract feels that compliance with the recommendations of the Federal Mine Inspectors, as provided above, would cause irreparable damage or great injustice, they may appeal such recommendation to the Joint Board of Review as hereinafter provided.

The Anthracite Wage Agreement of July 3, 1948, between the United Mine Workers of America and Anthracite Operators, provided in part as follows:

> Mine Safety Program.
>
> (a) Federal Mine Safety Standards.
>
> Inspectors of the Federal Bureau of Mines shall make periodic investigations of the mines, and report to the mine management and the United Mine Workers of America any violations of the Federal Safety Standards.
>
> Operators and Mine Workers agree to accept such standards of safety adaptable and practical to the anthracite industry, subject, however, to the right of review by the Director of the Federal Bureau of Mines, upon petition from the Operator or the United Mine Workers of America.

THE ADVISORY COMMITTEE

Section 8 of the Coal Mine Inspection and Investigation Act of 1941, Public Law 49, provides for the appointment of an Advisory Committee composed of not more than six members to exercise consultative functions, when required by the Secretary, in connection with the administration of the Act. The following persons are members of the Committee:

Thomas Kennedy, Vice President, United Mine Workers of America, Washington, D. C.

Percy Tetlow, Industrial Representative, United Mine Workers of America, Washington, D. C.

John T. Jones, Director, Labor's Non-Partisan League, Washington, D. C.

L. C. Campbell, Vice President, Eastern Gas & Fuel Associates, Coal Division, Pittsburgh, Pa.

T. J. Thomas, President, The Valier Coal Co., Chicago, Ill.

Cadwallader Evans, Jr., President, The Hudson Coal Co., Scranton, Pa.

EMPLOYMENT OF PERSONNEL

Applicants for the position of coal-mine inspector or mining engineer must meet the rigid requirements set up by the United States Civil Service Commission before their names can be included in the Civil Service Register. Successful applicants are selected from the register.

TRAINING OF PERSONNEL

Inspectors and engineers are given a 4-week intensive course of training at Pittsburgh, Pa. in technical matters and Bureau policy before being assigned to field headquarters. The training includes lectures and laboratory work covering such vital subjects as mine-rescue training, first-aid training, causes and prevention of mine fires and explosions, mine gases and methods of detection, electricity in mines, ventilation, explosives, methods of collecting and analyzing dust and air samples, method of conducting a coal-mine inspection, method of preparing inspection and investigation reports, operation of automobiles, and general policy matters.

Inspectors who complete the course of training are required to accompany experienced inspectors until they have demonstrated their ability to the supervisory official of the district to conduct inspections without immediate supervision. New inspectors are admonished to go slowly with their first inspections and to be very careful and thorough so that hazards are not overlooked. The need for thoroughness is emphasized throughout the training period and is reemphasized from time to time thereafter to avoid misunderstanding the Bureau's policy.

One or more coal-mine inspectors of outstanding ability are assigned in each Health and Safety Division field district to assist the district engineer in supervising the coal-mine inspectors under his jurisdiction. They accompany the inspectors and instruct them when necessary to improve the quality of their work. The supervising inspectors report their observations to the district engineer and to the Washington office for critical review and appropriate action.

In October and November 1948, a class of 63 coal-mine inspectors completed the course of training in Pittsburgh.

During September 1948, a class of 14 mining engineers, in addition to the 8 trained during the fiscal year 1948, was given special training in accident-prevention work so they would be able to instruct classes in accident prevention for coal-mine supervisory personnel and others interested in promoting health and safety in the Nation's coal mines.

ORGANIZATION

The Coal Mine Inspection Branch was allotted $2,431,500 for the fiscal year ended June 30, 1949. These funds provided for employment of 250 coal-mine inspectors, 22 mining engineers, 5 mining-explosives engineers, and 97 stenographers, clerks, and miscellaneous employees in the field, and for 3 administrative officials, 5 mining engineers, and 17 clerical employees in the departmental service.

The coal-mine inspectors and engineers employed in the field are directly under the jurisdiction of the supervising engineers of the long-established districts of the Health and Safety Division; they are headquartered at strategic places in coal-producing areas in the United States.

As of June 30, 1949, the Coal Mine Inspection Branch owned and operated 258 automobiles for official use in connection with inspection work.

Table 2 shows the number of inspectors employed by the Bureau since the establishment of Federal inspection of coal mines.

Inspection Procedure

The inspection of a mine may require a day to several weeks, depending on the size of the mine, the thickness and pitch of the coal beds, the system of mining, degree of concentration of working places, prevalence of hazardous conditions and practices, and other conditions.

TABLE 2. - Coal-Mine Inspectors Employed

Period	Number 1/
12/1/41 to 6/30/43	107
7/1/43 to 6/30/44	107
7/1/44 to 6/30/45	132
7/1/45 to 6/30/46	157
7/1/46 to 6/30/47	180
7/1/47 to 6/30/48	200
7/1/48 to 6/30/49	2/ 250

1/ These figures include vacancies and also inspectors who have been assigned to roof-control work, etc., which cannot be classed as regular inspection work.

2/ The 50 additional inspectors allotted during the fiscal year ended June 30, 1949, did not report for field duty until November 1948. New inspectors are given a course of training in Pittsburgh before being assigned to field headquarters, and they are required to accompany trained inspectors for about 2 months before they may inspect mines without immediate supervision.

Table 3 shows the number of complete coal-mine inspections and surveys made by Coal Mine Inspection Branch field personnel from December 1, 1941, to June 30, 1949. In the standard procedure for all coal and lignite mines the inspector is required to: (a) inspect the surface plant, every working place in the mine, all active haulageways and travelways, entrances to abandoned workings, accessible old workings, airways, escapeways and other places where men work or travel or where dangerous conditions may exist, electrical equipment and installations, haulage facilities, first-aid equipment, ventilation facilities, communication installations, roof and rib conditions, blasting practices, etc., and (b) to make tests for gas and oxygen deficiency in all mines and to collect samples of mine air and mine dust for chemical analysis, if necessary, to determine conditions with respect to gas and coal dust.

In multiple-shift operations the inspector is required to devote part of his time to inspection on each shift to observe hazards under all working conditions.

When an inspector observes unduly hazardous conditions or practices, he informs the local mine officials. If prompt action is not taken, he so advises the mine safety committeemen and the Bureau of Mines supervising engineer or engineer-in-charge, who, in turn notifies the head of the State inspection service and the local State inspector by telephone or telegraph (confirmed by letter) regarding the conditions and practices. Such procedure was adopted to enlist the cooperation of labor and the State law-enforcing agencies to eliminate hazards.

TABLE 3. - Record of Coal-Mine Inspections and Surveys, December 1, 1941, to June 30, 1949

Field District Headquarters	Period	Total regular inspections	Surveys			
			Electrical	Explosives	Ventilation	Float dust
	12/1/41 to 6/30/43	1,612				
	7/1/43 to 6/30/44	2,225				
	7/1/44 to 6/30/45	2,956	[1] 69	[1] 138		
	7/1/45 to 6/30/46	2,719	19	38		
	7/1/46 to 6/30/47	3,985	21	35	5	
	7/1/47 to 6/30/48	4,661	10	20	5	16
	7/1/48 to 6/30/49					
A Pittsburgh, Pa.		2,081				
B Wilkes-Barre, Pa.		625	5	5		
C Mt. Hope, W. Va.		1,695		2		
D Birmingham, Ala.		594				
E Vincennes, Ind.		877		1		
F Duluth, Minn.		21				
G Dallas, Texas		113				
H Salt Lake City, Utah .		667				
I Anchorage, Alaska		1				
Total..................	7/1/48 to 6/30/49	6,674	5	8		
Grand total...........	12/1/41 to 6/30/49	24,832	124	239	10	16

[1] Covers the period 12/1/41 to 6/30/45.

In some States the heads of the State inspection agencies, when informed of violations of State laws in Federal reports, promptly ordered the district State inspectors to investigate the reported violations and take appropriate action.

Each coal-mine inspector is assigned a district composed of mines that he inspects regularly. The assignment of an inspection district to each inspector results in a greater personal interest on the part of the inspector to have the mines under his jurisdiction in the safest possible condition and to keep accidents in them to a minimum. Each inspector is responsible for devising ways and means of reducing accidents in his district by promoting and attending safety meetings and by discussing accident-prevention measures with mine personnel. The inspectors are required to improve the effectiveness of their inspections by:

a. Determining the outstanding causes of accidents at the mine to be inspected; this information to be used during the inspection to guide him in observing hazards and suggesting ways of eliminating them.

b. Discussing observed hazards and means of correction with the accompanying official at the time the hazard is discovered, with the mine safety committeemen when feasible, and with the higher officials when a conference can be arranged.

c. Enlisting the cooperation of labor, management, State inspection personnel, and all other safety-promotion agencies.

d. Becoming acquainted with the officials of the mine workers' organization, the mine safety committee members, and the coal-mine officials.

e. Spending enough time at the active working faces to observe, wherever practicable, a complete cycle of operations, such as timbering, cutting, drilling, blasting, loading, and haulage.

f. Attending local union meetings occasionally to discuss safety with the members and endeavoring to promote cooperation in accident-prevention work.

g. Participating in mining institutes, Holmes Safety Association chapters and councils, and other agencies dedicated to the promotion of mine safety.

h. Assuming a personal interest in and responsibility for the prevention of accidents.

Standard Procedure for Handling and Distributing Coal-Mine Inspection Reports

The "Federal Mine Safety Code" is used as a basis for determining unsafe and unhealthful conditions and practices in bituminous-coal and lignite mines. The Bureau's "Safety Standards for Anthracite Mines" are used as a basis for determining unsafe and unhealthful conditions and practices in anthracite mines.

A preliminary report covering unsafe conditions and practices that are considered to be of primary importance is prepared by the inspector and posted by him in a conspicuous place at the mine within 1 day following completion of inspection. Typed copies of the preliminary reports are distributed from the field offices of the Bureau of Mines to the mine officials, the State mine-inspection agency, district and National headquarters of the mine workers' organization, the Washington office of the Bureau of Mines, and the Geological Survey if the mine is on the public domain or Indian land.

A final report on each inspection is prepared by the inspector after the preliminary report has been completed; it contains a general description of the property and of conditions and practices observed during the inspection. Each unsafe condition and practice is recorded in detail, and proper recommendations are made to correct them. Results of analyses of dust and air samples, collected during the inspection, are listed in the report to provide additional facts with respect to atmospheric and dust conditions in the mine.

If the final report indicates that disaster hazards existed or were developing at the time the mine was inspected, a special letter calling attention to such hazards is sent promptly to the president of the mining company by the Chief of the Health and Safety Division as soon as the inspection report is reviewed in the Bureau's Washington office. This procedure was adopted to attempt to enlist the cooperation of the heads of the mining companies in reducing or eliminating hazardous conditions and practices in the mines, particularly those that may result in heavy loss of life. The Bureau does not have the facilities or personnel to determine the action taken on these letters, but subsequent inspections have corroborated claims made by management that many of the hazards referred to were corrected. Some company presidents professed to have no knowledge of the existing hazards, but indicated they would take immediate steps to require prompt compliance with the recommendations; they also have indicated their appreciation of having accurate reports of the mines called to their particular attention in this manner. Since April 8, 1948, when this system was adopted, 7,872 coal-mine inspection reports have cleared the Washington office. Of this number, 2,475 reports (31 percent) contained statements of violations of the Federal Mine Safety Code or Anthracite Standards that appeared to constitute imminent danger, justifying notifications to the presidents of the companies.

Final reports on inspections of underground coal mines employing less than 25 men, those having a life of 6 months or less, and all strip mines are prepared, reviewed, and typed at the field offices and distributed therefrom to the mine officials; the State department of mines; the National and district offices of the proper mine workers' organization; the Joint Industry Safety Committee, if the mine (bituminous only) is affiliated with the United Mine Workers of America; and the Geological Survey, if the mine is on the public domain or Indian land.

A copy of each final inspection report is forwarded to the Office of Minerals Reports, Bureau of Mines, where a press release covering salient features of the report is prepared and sent to the newspapers in the area where the mine is situated.

The posting and distributing of the reports, the press releases covering them, and the filing of copies of the reports in the Bureau of Mines field and Departmental offices constitute compliance with section 6 of the act requiring publication and dissemination of findings.

Reports on explosives, electrical, ventilation, roof-control, and dust surveys by inspectors and engineers usually are transmitted only to officials of the particular mine in which the survey is made because the technical information in these reports is of particular interest only to the mine operator and Bureau of Mines personnel. However, copies of reports on such surveys are available in Bureau offices for public inspection. On numerous occasions such surveys are made at the request of mine operators; they are made primarily to improve health and safety conditions, but as efficiency and economy are so closely related to safety the recommendations generally are complied with readily.

The Bureau of Mines has no power under the act or under the Federal Mine Safety Code (effective July 1, 1947) to require compliance with recommendations. The act gives Bureau of Mines personnel only the right to enter mines for inspection purposes.

INSPECTION OF SMALL MINES

Funds were provided during the fiscal year ended June 30, 1949, for the employment of 50 additional coal-mine inspectors to enable the Bureau of Mines to inspect more of the thousands of small underground mines employing less than 25 men. Prior to 1949, the number of inspectors allotted was sufficient to inspect only the larger mines about twice a year, but because the accident rates in small underground mines are so much higher than reported for larger mines it was deemed advisable to concentrate on improving conditions and practices in the small mines.

During the fiscal year ended June 30, 1949, 2,031 small underground mines employing less than 25 men were inspected. The excessive number of unusually hazardous conditions and practices found during these inspections shows why so many accidents occur in small mines.

REGULAR INSPECTION WORK

Inspections of coal mines under the Coal Mine Inspections and Investigations Act began on December 1, 1941. From that date to June 30, 1949, a total of 24,832 complete regular Federal inspections of all types of coal mines were made.

SPECIAL ACCOMPLISHMENTS

Personnel of the Coal Mine Inspection Branch performed special work, as provided in Section 6 of the act, which authorizes and directs the Secretary of the Interior, acting through the Bureau of Mines, to expend the funds made available to him for the protection of health and advancement of safety in coal mines and for the prevention or reduction of accidents and occupational diseases therein in such lawful manner as he may deem most effective.

The outstanding special work accomplished during this fiscal year is described herein.

Accident Prevention Course of Coal-Mine Supervisory Officials

During the fiscal year ended June 30, 1949, Congress appropriated funds to provide for the employment of 22 mining engineers to teach coal-mine supervisory officials safety with respect to falls of roof and coal, ventilation, the handling and storage of explosives, use of electricity, transportation, explosions and fires, miscellaneous accidents, and other hazards identified in the "Federal Mine Safety Code for Bituminous-Coal and Lignite Mines" and in the "Safety Standards for Anthracite Mines." Such training ordinarily is not readily available to mine officials, and the need for it has long been apparent to the mineral industries and to the Bureau of Mines. Mine owners welcome such training, and past experience proves that the supervisory officials are eager to enroll in the courses offered.

The mining engineers assigned to this work were chosen because of their education and background of experience. Each has had years of experience in private industry in engineering, production, preparation, safety work, and public relations; all are capable of carrying out their assignments satisfactorily. The first group of eight engineers was given a special course of instruction at the Bureau's Central Experiment Station at Pittsburgh, Pa., in January 1948, and the second group of 14 was trained there in August 1948. These men have been conducting classes continuously in coal-mining regions, and up to June 30, 1949, a total of 3,376 mine officials completed training. It is estimated that 50,000 supervisory officials are employed in and around the Nation's coal mines.

In addition to conducting safety educational activities, the engineers are available to conduct investigations in coal mines and to offer proper recommendations for the solution of special problems involving detailed study. In the course of routine inspections by regular coal-mine inspectors, special problems arise relating to the method of mining, control of roof, ventilation, control of dust, drainage, subsidence, etc., that require detailed investigation before proper advice can be given to solve them. Such problems may require an engineering background not ordinarily possessed by coal-mine inspectors.

Training Program for Mine Safety Committeemen

The National Bituminous Coal Wage Agreement of 1948 provided in part, under the section headed Mine Safety Committee:

> At each mine there shall be a Mine Safety Committee selected by the local union. The Mine Safety Committee may inspect any mine development or equipment used in producing coal. If the Committee believes conditions found endanger the life and bodies of the mine workers, it shall report its findings and recommendations to the management. In those special instances where the Committee believes an immediate danger exists and the Committee recommends that the management remove all mine workers from the unsafe area, the Operator is required to follow the recommendation of the Committee.

In order that members of mine safety committees be well-versed in mine safety and in the provisions of the Federal Mine Safety Code and Safety Standards for Anthracite Mines and thereby be fortified better to cooperate with management in improving safety and health conditions and practices in coal mines, the Federal Bureau of Mines, in cooperation with the United Mine Workers of America, inaugurated a course of training for the mine safety committeemen in January 1947. This course of training, which is being conducted by coal-mine inspectors, is progressing satisfactorily, and up to June 30, 1949, 10,968 safety committeemen and other mine workers completed it. The program is being expanded to satisfy the increasing demand of mine-safety committeemen (estimated at about 12,000 men) throughout virtually all of the coal-producing States for the training offered by the Bureau of Mines. This course of training is available also to mine employees not covered by the National Bituminous Coal Wage Agreement. The interest manifested by the mine safety committeemen in the Bureau's training program indicates their desire to cooperate in the elimination of unsafe conditions and practices.

In view of the need for training approximately 400,000 mine employees (other than supervisory officials) in accident prevention, the training is being extended to cover such employees.

Roof-Control Work

Falls of roof and coal have caused about half the total fatalities in coal mines. Bureau of Mines engineers have studied roof-control measures whenever funds were available and have solved some special problems, such as that of "bumps." However, no new roof-control methods that could be applied generally throughout coal mines was discovered until 1948, when two mining engineers of the Coal Mine Inspection Branch, who were assigned to such work under provisions in Public Law 49, investigated a roof-control method used for years in metal mines in southeast Missouri, recognized its possibilities, and applied the method in coal mines. After enough experimental work was conducted to prove its value and practicability under actual operating conditions, the method known as "roof-bolting" was given wide publicity in Bureau publications and trade journals. Coal-mine inspectors have been assigned to assist in this work in response to many requests from mine operators who want to install the new type of roof support.

The principle involved in the new roof-control method is the prevention of initial sag and subsequent failure of thin bands of roof strata by reinforcing the strata with steel rods (bolts) as soon as the roof is exposed. Installations, supervised by Bureau of Mines personnel, have been made in numerous coal mines and in a few ore mines throughout the United States, and the results indicate that the method is successful in mines where the roof above the coal consists of thin strata that require some support.

As roof-bolting eliminates the need for timber sets (legs and collar) and posts, it is of special value in mechanized mines, where dislodgment of the standard support is likely to result in a fall of roof and possible fatal injury to persons in the immediate vicinity. The widespread interest shown by the coal-mining industry in this method of roof support and the marked reduction in roof-fall accidents where it has been applied is evidence of its great possibilities in reducing accidents from falls of roof - the number 1 man killer in coal mines.

Bureau of Mines engineers and coal-mine inspectors assigned to this work are continuing to conduct experiments to further improve and simplify the method and to determine its applicability to various mine-roof conditions. The results of such work will be published from time to time in accordance with Bureau policy.

Examinations of Mines Made to Determine Applicability of Roof Bolting

During the fiscal year 1949, in answer to numerous requests by coal companies, roof and mining conditions in 115 mines in 11 States were examined by personnel of the roof-control section to determine whether roof-bolting was applicable to the local conditions. Such examinations were followed by conferences with company officials, and recommendations were made with respect to the installation of roof-bolts. Details on technique and fabrication of materials were discussed.

Installations

Roof bolts have been installed in 60 bituminous-coal mines and 8 iron-ore mines in 8 States, and it is estimated that 30 miles of mine passageways are now supported by them.

Laboratory Studies

During the fiscal year, a stratascope was developed and was near completion at the Naval Gun Factory Optical Shop. This instrument will provide precision and accuracy in determining strata separation, which usually precedes failure, and thereby reduce accidents from falls of roof.

A "torquometer" was obtained near the close of the fiscal year, and some bolt-tension determinations were made at two installations where roof bolts were installed, but the data are too fragmentary to draw sweeping conclusions. To supplement the field data, a schedule of laboratory tests has been devised to determine factors that may affect ultimate results. Indications are that the "torquometer" readings will provide significant information relating to effectiveness of roof-bolt anchorages.

A centrifuge has been designed, and necessary materials have been ordered for its construction. This centrifuge will be larger than those employed for barodynamic tests at Columbia University and will provide means for studying a greater variety of problems than has been possible heretofore.

Meetings

During the fiscal year, 21 meetings were attended by the personnel of the roof-control section at which papers or lectures were delivered on the subject of roof control.

Ventilation

Ventilating-pressure surveys and other technical studies on ventilating facilities were made by a mining engineer assigned to such work, generally at the request of mine operators who were desirous of improving the efficiency, economy, and safety of the ventilating system at their respective mines.

Air-Borne Mine Dusts

During the period January 21-31, 1946, a course of instruction on "Determination and Control of Unhygienic Dusts" was given by the Health Branch to 20 employees of the Safety and Coal Mine Inspection Branches of the Health and Safety Division; these men represented the different field offices of the Division.

The object of this training was to provide each district with a qualified dust expert to cooperate with the Health Branch and make field determinations in coal and noncoal mines with respect to the amount of float dust in the atmosphere. Such data are used in determining the concentrations of dusts that are considered to be unhealthful. Information is being collected from time to time, but as yet no specific conclusions have been arrived at for publication.

Electrical Surveys

The mining-electrical engineers of the Coal Mine Inspection Branch conducted special electrical surveys of coal mines to determine unsafe practices and installations so that proper corrective recommendations could be made. These engineers are especially qualified to conduct such surveys, whereas the coal-mine inspectors generally are not equipped, by education or experience, to make them. The services of the mining-electrical engineers are requested by mine operators and by the Joint Industry Safety Committee operating under the National Bituminous Coal Wage Agreement. They also are assigned to special studies to provide safer and more efficient electric equipment for the mining industry. A major study underway is the development of improved devices that will offer better protection against short circuits in mines. If such equipment is perfected and approved by the Bureau of Mines, the mining industry will be notified in the customary manner.

Explosives Surveys

Mining-explosives engineers of the Coal Mine Inspection Branch conducted special investigations with respect to the safe storage, transportation, and use of explosives and blasting devices. They also made regular explosives surveys of coal mines to point out unsafe blasting conditions and practices and recommended ways of improving the safety and efficiency of operations.

The Bureau of Mines has advocated the exclusive use of permissible explosives or blasting devices in coal mines and has recommended against the use of black blasting powder and dynamite, which have caused so many gas and dust explosions, with attendant heavy casualities. The mining-explosives engineers did a considerable amount of educational work demonstrating to mine operators, by performance tests in the mines, that permissible explosives are much safer and just as economical as black blasting powder. Through their efforts and the efforts of the regular coal-mine inspectors, the use of dangerous black blasting powder was discontinued in 94 coal mines during the fiscal year ended June 30, 1949.

Federal Coal-Mine Inspectors Assigned to Special Duty

Cooperation with other Departments of the Federal Government included the following assignments of personnel of the Coal Mine Inspection Branch to special domestic and foreign duty.

a. Three coal-mine inspectors were loaned to the Department of the Army to conduct special investigations in coal mines in Europe for 9 months, beginning in January 1948. These three men were replaced by two other coal-mine inspectors, who began their assignments in April 1949.

b. One coal-mine inspector was lent to the Department of the Army on January 6, 1949, for special duty for 1 year in Korea to assist in executing the fuel program of that country.

c. One coal-mine inspector was lent to the Economic Cooperation Administration for special assignment on mining problems in Turkey for 2 years beginning in May 1949.

d. One coal-mine inspector has been working intermittently for the Department of the Army making special studies of coal-mine regions of the United States in connection with the Government's synthetic liquid fuels program.

e. One coal-mine inspector was detailed to the Government of Australia to determine suitable methods of recovering pillars in thick beds in that country.

Such assignment of personnel to duties outside the Bureau of Mines serves a twofold purpose: (1) The agency to which Bureau experts are assigned obtains the benefit of their wide experience, and the persons so assigned augment their fund of knowledge; and (2) the additional information obtained through special assignments of Bureau personnel is made available to the mining industry provided such action is deemed in the public interest.

Cooperation with State Agencies and the United Mine Workers of America in the Revision of State Mining Laws

In November 1949, the Bureau of Mines was requested by the Governor-elect of Illinois to offer comments on the then existent coal-mining laws of Illinois and to make suggestions for improving them and the operation of the Department of Mines and Minerals in Illinois. This request was complied with promptly; suggested revisions of the Illinois laws were offered by personnel of the Coal Mine Inspection Branch and forwarded to the Governor-elect of Illinois on December 9, 1948.

On February 21, 1949, the Governor of Colorado requested the comments of the Bureau of Mines on a bill to revise the coal-mining laws of Colorado. Personnel of the Coal Mine Inspection Branch reviewed the provisions of Colorado Senate Bill No. 41, and the comments were submitted to Governor W. L. Knous on March 3, 1949.

During the fiscal year the United Mine Workers of America requested and received assistance in revision of the coal-mining laws of Arkansas, Oklahoma, Ohio, Montana, and Maryland so that the suggestions could be presented to the several State legislatures for consideration. Such cooperation enabled representatives of the United Mine Workers of America to obtain enactment of modernized coal-mining laws in Montana and Maryland and improvement in the laws of Oklahoma, Ohio, and Arkansas. Personnel of the Coal Mine Inspection Branch were invited by the Assistant Attorney General of Maryland to attend public hearings and offer comments on the proposed bills to revise the Maryland mining laws; the invitation was accepted. The hearings at Cumberland and Annapolis, Md., were attended on February 19, 1949, and March 10, 1949, respectively.

Senate Bill 1031 and House of Representatives Bill 3023, 81st Congress, 1st Session

S. 1031 and H.R. 3023 are two virtually identical bills that propose to amend Public Law 49 by giving Federal coal-mine inspectors authority to order withdrawal of workmen from a mine or any portion thereof in which imminent dangers exist. The Subcommittee of the Sendate Committee on Labor and Public Welfare held public hearings on S. 1031 in May 1949; at the invitation of this committee, J. J. Forbes, Chief of the Health and Safety Division, M. J. Ankeny, Chief of the Coal Mine Inspection Branch, and G. W. Grove, Supervising Engineer, District A, Health and Safety Division, testified on the bill at hearings on May 17, 25, and 26, 1949. The Subcommittee of the House of Representatives Committee on Education and Labor held public hearings on H. R. 3023 in June 1949; at the invitation of this Committee, J. J. Forbes testified on this bill on June 16 and Messrs. Ankeny and Grove testified on June 17, 1949.

ACHIEVEMENTS

The basic purpose of the Coal Mine Inspections and Investigations Act of 1941 was to bring about a reduction in fatal and non-fatal injuries in coal mines; consequently, the effectiveness of work done by personnel of the Branch will be judged by the accident data covering the coal mines in the Nation.

The general trend of fatality rates based on man-hours of exposure in bituminous-coal and lignite mines (see fig. 1 and tables 4, 5, and 6) was upward during the 9-year period (1933 to 1941, inclusive) prior to Federal inspections of coal mines. In 1942, when such inspections got well under way, the trend was reversed, and the downward trend has been generally maintained since 1942 despite the unfavorable factors and influence that obtained during the war years.

The general trend in nonfatal injury rates based on man-hours of exposure in bituminous-coal and lignite mines (see fig. 2 and tables 4, 5, and 6) has been downward since 1935. There has been no outstanding change in the general trend of nonfatal rates since 1933, but the trend has been favorable.

The general trend of fatality rates based on man-hours of exposure in anthracite mines (see fig. 3 and tables 4 and 5) was upward during the 9-year period (1933 to 1941, inclusive) prior to Federal inspections of coal mines. However, in 1942, when Federal inspections got well under way, the trend in fatality rates turned downward and has been so maintained ever since. In fact, the fatality rate in anthracite mines in 1948, based upon man-hours of exposure, is the best annual record in the statistical history of anthracite mining.

The general trend in nonfatal injury rates based on man-hours of exposure in anthracite mines (see fig. 4 and tables 4 and 5) was upward during the 9-year period (1933 to 1941, inclusive) prior to Federal inspections of coal mines. In 1942, the trend in nonfatal rates started abruptly downward to a level never obtained previously, and the favorable trend is being maintained.

The major coal-mine disasters (a major disaster is one in which five or more fatalities occurred) that occurred in coal mines of the Nation during the fiscal year ended June 30, 1949, are listed in table 7 and shown graphically in figure 5. Federal coal-mine inspection reports indicate disaster hazards in existence in many coal mines, particularly in those employing fewer than 25 men. However, the reports also establish proof that generally the larger well-managed mine is being rock-dusted to forestall propagation of a widespread dust explosion, and as a result of such safeguard a widespread disaster with large loss of life is less likely to occur.

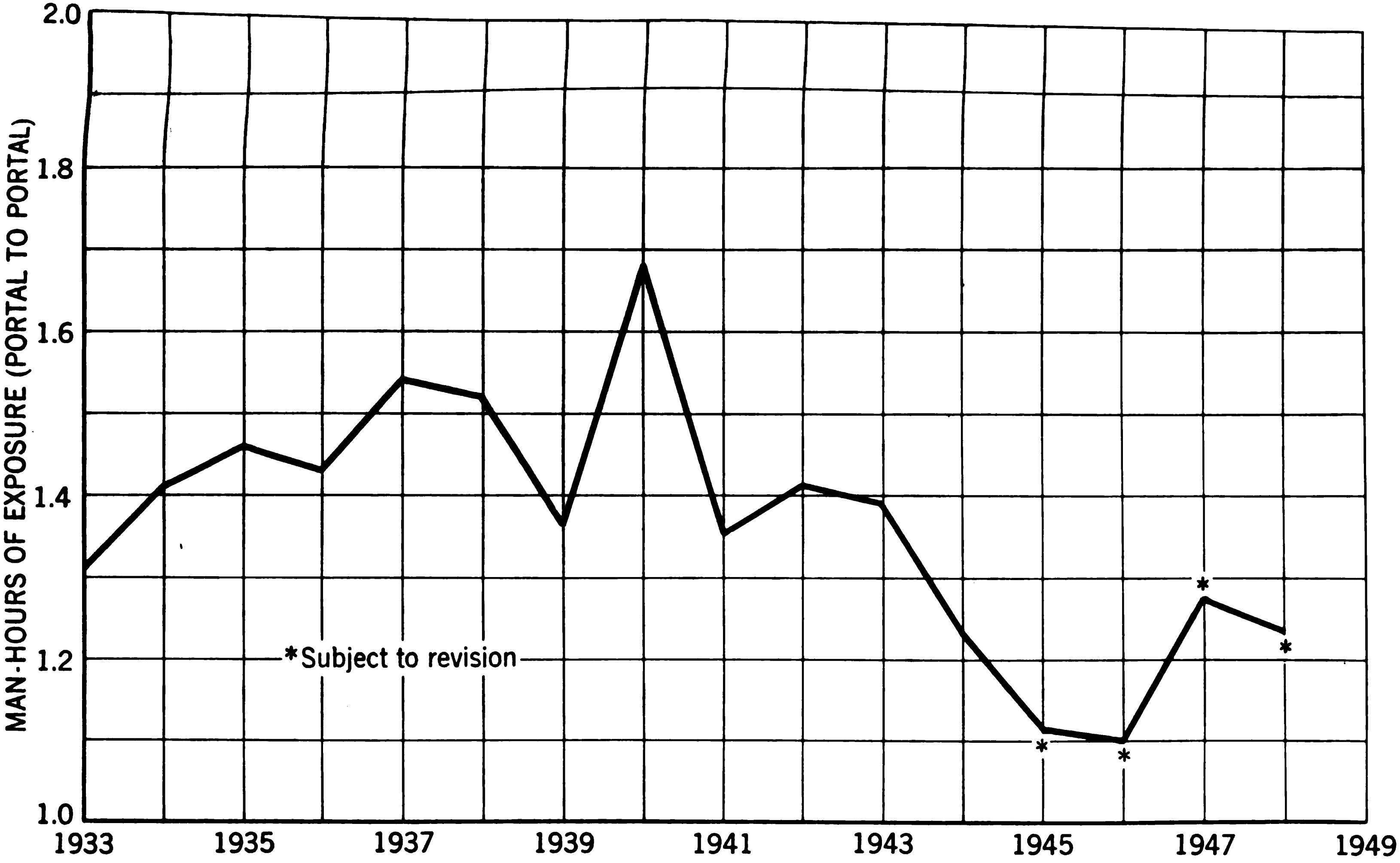

Figure I. - Fatality rates in bituminous-coal mines of the United States based on man-hours of exposure (portal to portal).

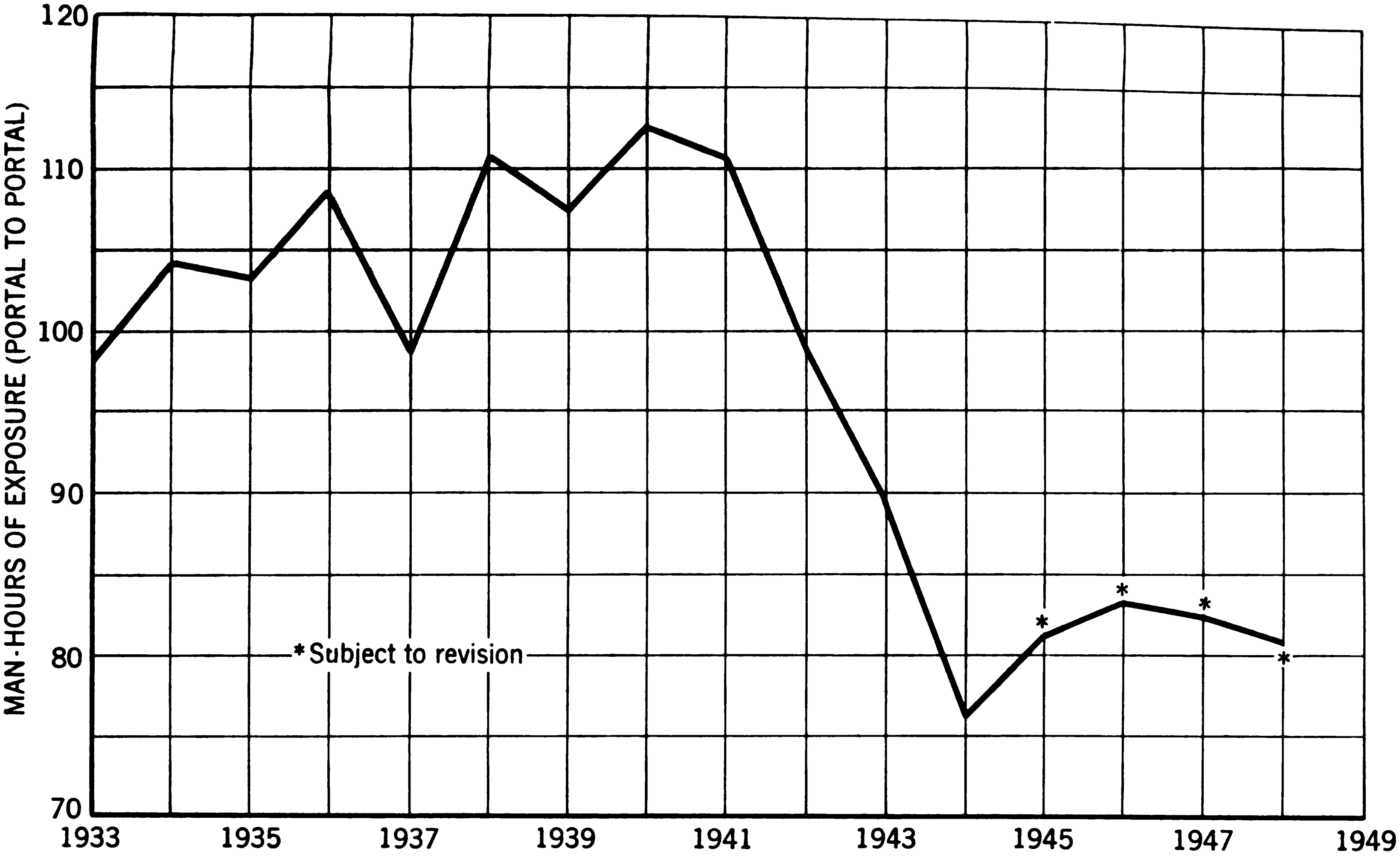

Figure 4. - Nonfatality rates in anthracite mines of Pennsylvania based on man-hours of exposure (portal to portal).

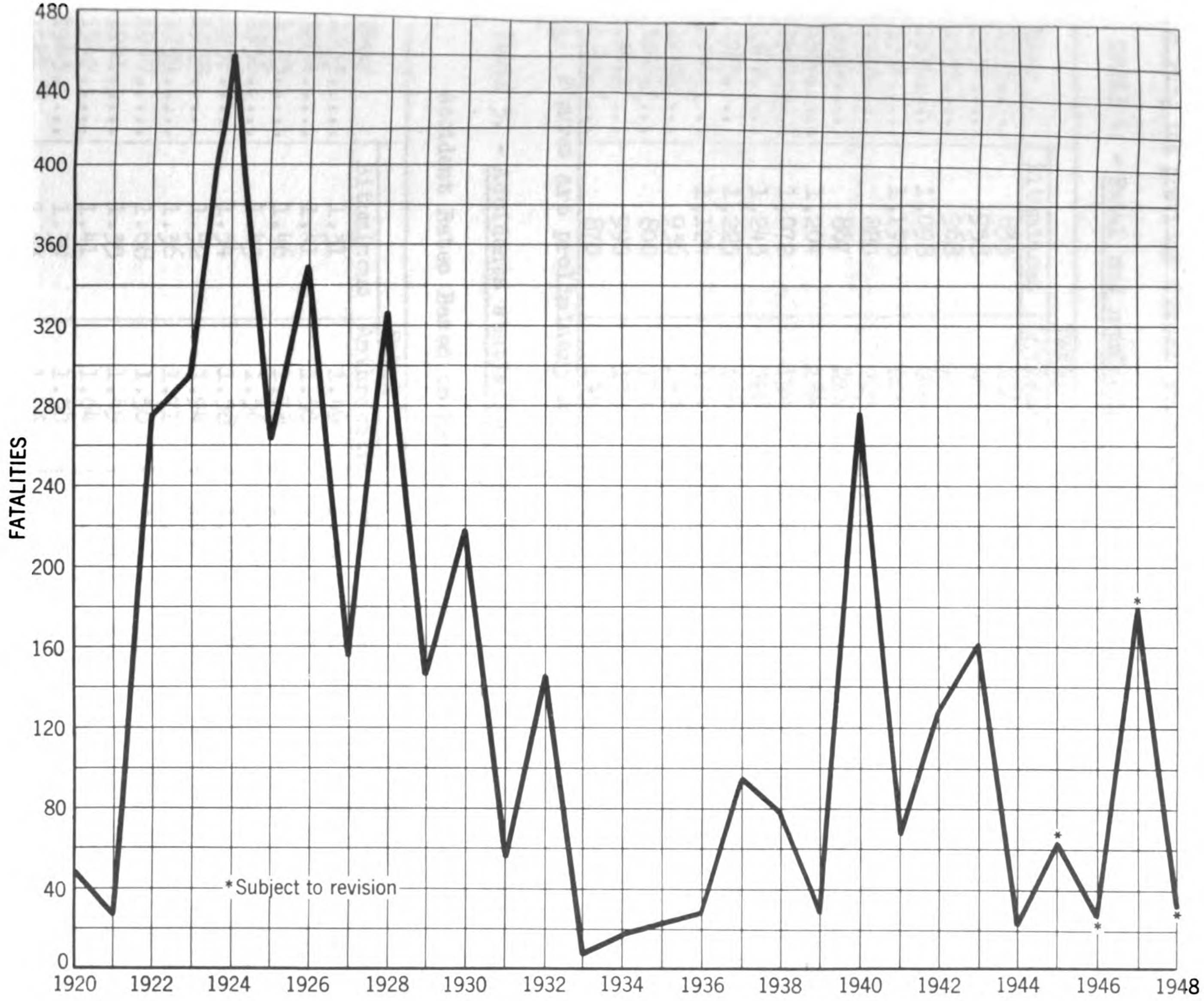

Figure 5. - Fatalities in major gas or dust explosions in bituminous-coal and anthracite mines of the United States.

The coal mines that were free of violations of the Federal Mine Safety Code and Safety Standards for Anthracite Mines at the time of inspection during this fiscal year are recorded in table 8. Attention is invited to the fact that five of those mines were free of code violations when inspected during the previous fiscal year ended June 30, 1948.

TABLE 4. - Fatal and nonfatal injuries in coal mines in the United States

	Fatal			Nonfatal		
Year	Bituminous	Anthracite	Total	Bituminous	Anthracite	Total
1933.....	833	231	1,064	43,946	15,183	59,129
1934.....	958	268	1,226	46,982	18,577	65,559
1935.....	968	274	1,242	47,529	15,897	63,426
1936.....	1,098	244	1,342	50,514	17,026	67,540
1937.....	1,198	215	1,413	52,847	13,412	66,259
1938.....	880	225	1,105	36,794	12,842	49,636
1939.....	867	211	1,078	38,544	13,229	51,773
1940.....	1,204	184	1,388	43,994	13,782	57,776
1941.....	1,072	194	1,266	46,637	14,420	61,057
1942.....	1,245	226	1,471	53,193	13,581	66,774
1943.....	1,225	226	1,451	51,067	13,527	64,594
1944.....	1,124	174	1,298	51,253	12,438	63,691
1945 1/...	936	143	1,079	47,750	11,600	59,350
1946 1/...	800	174	974	44,000	12,800	56,800
1947 1/...	990	175	1,165	45,700	12,500	58,200
1948 1/...	870	145	1,015	41,500	12,600	54,100

1/ Figures are preliminary and subject to revision.

TABLE 5. - Accidents statistics covering coal mines in the United States

Accident Rates Based on Man-hours Exposure, Portal to Portal

	Fatal			Nonfatal		
Year	Bituminous	Anthracite	Total	Bituminous	Anthracite	Total
1933.....	1.31	1.49	1.34	68.87	98.13	74.58
1934.....	1.41	1.50	1.43	69.39	104.15	76.64
1935.....	1.46	1.78	1.52	71.47	103.16	77.43
1936.....	1.43	1.56	1.45	65.62	108.80	72.92
1937.....	1.54	1.58	1.55	68.05	98.72	72.62
1938.....	1.52	1.94	1.59	63.47	110.85	71.36
1939.....	1.36	1.71	1.42	60.53	107.37	68.12
1940.....	1.68	1.50	1.65	61.28	112.56	68.75
1941.....	1.35	1.49	1.37	58.93	110.83	66.26
1942.....	1.41	1.64	1.44	60.21	98.73	65.40
1943.....	1.39	1.50	1.40	57.79	89.68	62.44
1944.....	1.23	1.06	1.20	56.02	76.05	59.06
1945 1/...	1.11	1.00	1.10	56.78	81.12	60.32
1946 1/...	1.10	1.13	1.10	60.27	83.12	64.25
1947 1/...	1.27	1.15	1.25	58.50	82.24	62.37
1948 1/...	1.23	.93	1.17	58.45	80.83	62.48

1/ Figures are preliminary and are subject to revision.

TABLE 6. - Fatalities and comparison of fatality rates based on man-hours exposure in UNDERGROUND bituminous coal mines, by employment groups

Year	Fatalities1/	Number of men employed				
		1-4	5-9	10-24	1-24	25 and over
1936........	117	12.38	2.49	2.00	3.79	1.73
1937........	114	11.55	2.88	1.93	3.72	1.90
1938........	101	9.79	2.44	2.03	3.63	1.85
1939........	95	8.35	2.27	1.33	3.06	1.71
1940........	119	7.24	2.70	2.60	3.67	2.10
1941........	123	7.20	3.45	1.99	3.34	1.65
1942........	101	6.22	2.27	1.68	2.61	1.79
1943........	80	6.00	1.62	1.14	1.95	1.84
1944........	103	5.25	1.73	1.59	2.08	1.56

1/ These fatalities occurred in underground bituminous coal mines employing less than 25 men.

NOTE. - These data cover only underground employees. They do not include surface employees nor strip-mine employees. The man-hours are based on working time and not on portal-to-portal time. The data for 1944-1949 are not available.

TABLE 7. - Major disasters in bituminous-coal and anthracite mines during the fiscal year ended June 30, 1949

Date	Mine	Company	State	Type of disaster	Fatalities
7/27/48.....	King	Princeton Mining Co.	Indiana	Explosion	13
7/30/48.....	Edgewater	Tennessee Coal, Iron & Railroad Company	Alabama	Explosion	11
8/6/48......	Berwind No. 11	New River & Pocahontas Consolidated Coal Co.	W. Virginia	Fall of roof	6
11/4/48.....	Nethken	George Nethken Co.	Maryland	Fire	5
Total.......					34

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TABLE 8. - Coal mines inspected during the fiscal year ended June 30, 1949, and found free of violations of the Federal Mine Safety Code for Bituminous-coal and lignite mines or the safety standards for anthracite mines

Mine	Company	State	Inspection date
Foster	Montana Coal & Iron Co.	Mont.	7/12-14/48
Pictou	Colorado Fuel & Iron Co.	Colo.	7/28/48
No. 1	Schull-Mooke Coal Co.	Ill.	8/24-25/48
Oliver No. 2[1]	Eberly Coal & Coke Co.	Pa.	9/10-13/48
Colonial Plant	H. C. Frick Coke Co.	Pa.	9/22-30/48
Queenwood No. 3	Imperial Smokeless Coal Co.	W. Va.	10/11-13/48
Rosebud[2]	Foley Bros. Inc.	Mont.	11/3/48
Sunnyside No. 2	Kaiser Co. Inc.	Utah	10/19-22/48
Praco, No. 11[1]	Alabama By-Products Co.	Ala.	11/22/48
Kyle[1]	H. C. Frick Coke Co.	Pa.	12/2/48
Hamilton	Tennessee Coal, Iron & R. R.	Ala.	12/13-30/48
Edgewater[1]	do.	Ala.	1/6-14/49
Eureka No. 42	Berwind-White Coal Mining Co.	Pa.	12/21-22/48
Hanna	The Hanna Mines	Pa.	3/10/49
Dakota Star[2]	Truax Traer Coal Co.	N. Dak.	3/10-11/49
Indian Head[2]	Dakota Collieries Co.	N. Dak.	3/9-10/49
No. 10	U. S. Coal & Coke Co.	W. Va.	4/14-20/49
Sunnyside No. 2	Kaiser Co. Inc.	Utah	4/25-28/49
Rockvale No. 3	Colo. Fuel & Iron Co.	Colo.	3/21-23/49
Black Diamond (1 and 2)[1]	Black Diamond Coal Mining Co.	Ala.	5/9-12/49
Kimberly No. 4	Sloss-Sheffield Steel & Iron	Ala.	5/24-25/49
Ronco	H. C. Frick Coke Co.	Pa.	6/1-3 & 6-7/49
Beer[2]	Beer Coal Co.	Colo.	5/18/49

[1] These mines were free of violations when inspected during the fiscal year ended June 30, 1948.

[2] Strip mine.

The extent of compliance with Federal recommendations to correct unsafe conditions and practices observed during inspections of coal mines from December 1, 1941, to June 30, 1949, by States, is recorded in table 9. The decrease in compliance during the fiscal year 1949, as compared to 1948, is due to inspection, for the first time, of more than 2,000 small underground mines employing less than 25 men. Past experience indicates that generally there is less compliance in small mines than in large ones.

TABLE 9. - Records of compliance with recommendations of Federal coal-mine inspectors, by States

State	Percent compliance			
	12/1/41 to 5/31/46	6/1/46 to 6/30/47	7/1/47 to 6/30/48	7/1/48 to 6/30/49
Alabama	-	20	41	12
Arizona	-	26	66	33
Arkansas	-	18	24	15
Colorado	-	39	53	31
Georgia	-	-	-	0
Illinois	-	17	38	24
Indiana	-	17	37	23
Iowa	-	14	13	12
Kansas	-	1	7	9
Kentucky	-	23	35	18
Maryland	-	7	45	31
Michigan	-	27	36	20
Missouri	-	10	26	8
Montana	-	23	28	27
New Mexico	-	30	46	33
North Dakota	-	36	47	40
Ohio	-	27	39	22
Oklahoma	-	20	24	21
Oregon	-	-	49	-
Pennsylvania (bituminous)	-	41	59	38
Pennsylvania (anthracite)	-	25	25	31
Tennessee	-	8	29	11
Utah	-	35	52	42
Virginia	-	29	37	23
Washington	-	41	37	26
West Virginia	-	33	41	39
Wyoming	-	31	45	26
	25	29	41	[1]28

[1] Decrease in percent compliance due to the inspection of 2,031 underground mines employing less than 25 men.

The number of coal mines in which major improvements were made during the fiscal year ended June 30, 1949, by States, is shown in table 10.

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TABLE 10. - Number of coal mines inspected in which major improvements were made during the fiscal year ended June 30, 1949

Improvement items	Ala.	Ariz.	Ark.	Colo.	Ga.	Ill.	Ind.	Iowa	Kans.	Ky.	Md.	Mich.	Mo.	Mont.	N. Dak.	N. Mex.	Ohio	Okla.	Pa., bit.	Pa., anth.	Tenn.	Utah	Va.	Wash.	W. Va.	Wyo.	Totals	
																										7/ 1/48-6/30/49	12/ 1/41-6/30/49
Method of systematic timbering adopted	3	-	2	8	-	11	8	2	-	51	-	-	-	-	-	-	21	4	36	8	9	-	6	-	44	-	213	1,343
Timbering plan enforced this year	15	-	3	26	-	34	15	1	-	77	6	-	1	5	-	3	26	10	129	55	9	13	23	1	153	14	619	2,758
Use of black blasting powder discontinued	4	-	1	5	-	3	4	-	-	23	1	-	2	1	-	2	4	2	27	4	6	-	2	-	2	1	94	666
Improved surface explosives-storage facilities	5	-	1	11	-	18	8	1	1	52	1	2	-	1	9	-	12	10	61	32	8	9	11	1	107	4	365	2,671
New main fan or fans installed	3	-	1	5	-	23	9	-	2	65	2	-	-	2	-	1	10	5	51	12	8	8	16	-	98	1	322	1,333
Ventilation improved in face regions	15	1	10	70	-	119	35	5	1	107	6	1	1	8	2	7	26	12	120	86	11	28	21	4	153	16	865	4,437
Use of blower fans discontinued	4	-	2	-	-	8	1	-	-	5	-	-	-	1	-	-	2	3	10	5	2	-	1	-	5	-	49	394
Mines classed gassy by States	-	-	-	-	-	1	-	-	-	5	-	-	-	-	-	-	-	-	3	3	1	1	-	-	2	-	16	62
Mines operated as gassy as result of Federal recommendation	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	1	2	1	-	1	1	-	1	-	10	76
Preshift examination for gas started	3	-	1	13	-	11	7	-	-	29	4	-	-	6	-	1	15	5	68	14	5	16	4	-	56	2	260	1,577
Onshift examinations for gas started	3	-	5	2	-	14	6	-	-	18	2	-	-	4	-	-	16	11	35	28	3	3	2	2	45	-	199	1,413
Started using water to allay dust in face regions	3	-	1	3	-	32	3	-	-	6	-	-	-	-	-	-	4	3	21	7	-	7	2	-	25	11	128	682
Use of rock dust adopted for first time	-	-	-	2	-	7	2	-	1	28	1	-	-	-	-	-	-	1	30	-	3	-	5	-	33	-	113	1,080
General improvement in rock dusting in mines previously rock dusted	9	-	1	99	-	100	17	1	-	106	1	-	-	7	-	4	17	4	71	-	3	35	34	-	157	10	676	2,620
General improvement in haulage practices	14	-	2	35	-	24	11	2	-	41	2	-	1	5	9	-	19	1	72	41	1	10	6	-	98	4	398	3,300
General improvement in haulage equipment	5	-	1	13	-	14	14	1	-	17	2	1	1	2	-	2	7	-	38	56	-	7	1	2	62	5	251	2,103
Nonpermissible electric equipment being replaced by permissible equipment	9	-	1	2	-	14	1	-	-	9	-	-	-	5	-	-	6	-	26	3	2	10	2	1	53	5	149	655
Installation of protective devices for electric equipment and circuits	14	-	4	52	-	70	35	3	1	77	5	-	3	8	4	5	35	4	112	239	-	28	24	-	162	13	898	4,320
Electric equipment frame grounded	14	-	5	56	-	26	26	1	1	57	7	-	-	3	3	1	16	3	139	61	3	17	15	2	154	7	617	3,196
Procedures adopted to follow in event of fire or explosion	1	-	-	3	-	11	8	2	-	4	-	-	-	-	2	1	1	2	27	-	-	5	-	-	7	1	75	682
Second opening provided	1	-	-	2	-	5	5	-	2	8	1	-	-	1	-	-	-	1	11	6	2	3	1	-	10	2	61	426
Additional escapeways provided from sections to surface	2	-	4	1	-	12	4	-	1	19	-	-	-	2	-	-	9	3	44	8	-	1	-	-	43	-	153	766
Smoking underground discontinued	2	-	3	9	-	7	2	-	-	19	2	-	-	3	1	-	4	5	27	25	-	2	3	-	54	2	170	814
Use of open lights discontinued underground	1	-	-	5	-	12	4	1	-	22	1	-	-	-	-	-	2	1	29	10	1	3	6	-	20	-	118	738
Use of safety hats adopted	2	-	1	14	-	17	13	-	-	34	1	-	1	3	1	3	5	5	56	16	4	3	2	1	5	3	190	874
Use of safety-toe shoes adopted	1	1	-	16	-	6	3	-	-	40	3	-	-	11	2	3	2	2	64	25	2	16	3	-	18	2	220	686
Use of goggles adopted	2	1	-	14	-	2	2	-	-	12	-	-	-	3	-	5	4	-	76	12	1	4	7	-	54	-	199	719
Safety meetings of men and officials	1	-	-	-	-	3	-	-	-	13	-	-	-	3	-	-	-	2	110	-	-	3	-	-	27	7	169	535
Mine safety committee active	10	-	2	1	-	35	4	1	-	126	7	-	3	7	-	-	2	2	258	-	7	18	43	-	205	18	749	2,307

CONCLUSIONS

Whereas the records prove beyond doubt that Federal inspections of coal mines resulted in a more rapid decrease in the fatal and nonfatal injury rates based on man-hours exposure, they also indicate that much more must be done before accident rates in coal mines will be in line with those of other major industries. The favorable results obtained during the 7 years of Federal coal-mine inspections are attributed to numerous factors and influences, of which the outstanding ones are:

a. Federal inspectors brought to light many hazards that had been overlooked or ignored by management, labor, and State mine inspectors. The widespread publicity given to Federal reports that exposed the unsafe conditions and practices resulted in greater effort on the part of all concerned to avoid such unfavorable publicity.

b. The contracts between the majority of the coal-mine operators and the United Mine Workers of America provided for acceptance of the Federal Mine Safety Code and Federal Safety Standards for Anthracite Mines as minimum standards for health and safety conditions and practices in coal mines. The operators agreed, by contract, to comply with the recommendations made by Federal coal-mine inspectors to correct unsafe conditions and practices disclosed by the reports.

c. The National Bituminous Coal Wage Agreement and Anthracite Wage Agreement provide for mine safety committeemen, who are selected by the local union and are authorized to inspect any mine development or equipment used in producing coal and to report their findings and recommendations to management. The functioning of these committees has brought about better understanding of the need for cooperation between management and labor to maintain safer operating conditions and practices.

Federal coal-mine inspectors have no authority under the Coal Mine Inspections and Investigations Act to require compliance with their recommendations. The influences, such as those recorded above, that caused the more rapid improvement in coal-mine accident rates since Federal inspections began probably will continue to have a favorable effect upon the accident rates, but such influences may not continue indefinitely to be as effective as they were during the past 7 years. The accident-prevention courses for coal-mine supervisors, mine safety committeemen, and other coal-mine workers, which are being conducted by the Coal Mine Inspection Branch of the Bureau of Mines, are expected to provide the additional impetus needed to at least maintain and possibly increase the present interest in mine safety. Roof bolting, which was successfully adapted to many coal mines by personnel of the Branch during the fiscal year 1949, is considered to be an outstanding contribution toward overcoming the roof-fall hazard in coal mines.

CONTROL OF FIRES IN INACTIVE COAL DEPOSITS

Uncontrolled fires in exposed inactive coal beds have caused the loss of thousands of acres of valuable coal reserves, damage or destruction of considerable surface property, and have menaced the lives and health of persons in proximity to such fires. Bureau of Mines' activities have been limited to investigations and recommendations, and funds for corrective action were not available until the fiscal year 1949, when the Congress provided $250,000 to control fires in inactive coal deposits.

Bureau engineers investigated 67 fires in inactive coal deposits during the fiscal year. The $250,000 was wholly inadequate for controlling all of these fires, and only those urgently requiring attention were selected for control. Contracts were let for seven fire-control projects, as follows:

1. I. H. I. mine outcrop fire near Rifle, Garfield County, Colo. on the public domain. It is estimated that 1,600,000 tons of coal was endangered by this fire. This project was completed in July 1949 at a cost of $39,867.

2. North Park outcrop fire near Coalmont, Jackson County, Colo., on the public domain, is in a coal bed averaging 40 feet in thickness. A contract has been let to control this fire at an estimated cost of $57,750. This project was expected to be completed during October 1949. Approximately 5 million tons of coal will be conserved through completion of this project.

3. Moyer Gulch outcrop fire is on public domain in a 40-foot bed of subbituminous coal near Gillette, Campbell County, Wyo., and endangers an estimated 6 million tons of coal. A contract to control this fire was let in June 1949 at an estimated cost of $56,000.

4. Peach Mountain outcrop fire near Pottsville, Schuylkill County, Pa. is on private property and endangers approximately 2 million tons of valuable anthracite. A contract has been awarded to control this fire at an estimated cost of $30,000, of which the Federal Government will pay $20,000 and Schuylkill County will pay $10,000. This project will be completed during October 1949.

5. Lloydsville outcrop fire near Latrobe, Westmoreland County, Pa., endangers 75 residences and their occupants, a manufacturing plant, and a main-line railroad. A contract to control it has been awarded at a cost of $12,000, and one phase of the control operation has been completed. This fire is on private property, hence the Government will pay two-thirds of the cost of control.

6. Monessen outcrop fire in the Borough of Monessen, Westmoreland County, Pa., endangers a public school and a large residential district. To control this fire contracts have been awarded for $12,223, of which the Government will pay two-thirds and the Borough of Monessen will pay one third.

7. An outcrop fire on the Experimental Mine and adjoining property at Bruceton, Allegheny County, Pa., endangers the mine and experiment station where much of the Bureau's research and investigative work is done. Contracts to control this fire have been awarded at an estimated cost of $45,000, two-thirds of which will be borne by the Government and one-third by private property owners.